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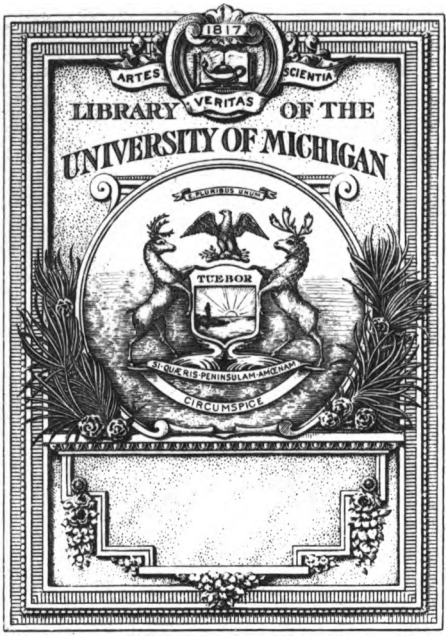

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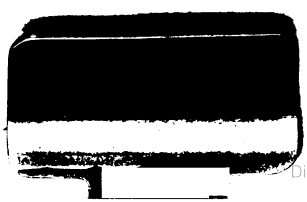

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TWENTY-THIRD REPORT

(TENTH BIENNIAL)

OF THE

New Hampshire

STATE BOARD OF HEALTH

OF THE

STATE OF NEW HAMPSHIRE

FOR THE FISCAL PERIOD ENDING AUGUST 31, 1914

CONCORD, NEW HAMPSHIRE
1914

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STATE OF NEW HAMPSHIRE.

OFFICE OF THE STATE BOARD OF HEALTH.

STATE HOUSE, CONCORD, September 1, 1914.

To His Excellency the Governor and the Honorable Council:

I have the honor to submit herewith, in accordance with the laws of the State of New Hampshire, the twenty-third report of the State Board of Health for the two fiscal years ending August 31, 1914.

Respectfully submitted,

IRVING A. WATSON,
Secretary.

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REPORT.

The activities of the State Board of Health during the biennial period, 1913, 1914, are only partially represented in this report. A limit to its size prevents the inclusion of many matters of importance in connection with the educational, advisory and executive work of the board. It has been thought best, as a matter of instruction and record, to devote the major part of this publication to the work done in connection with the examination of public water supplies of the state, food and drug examinations, bacteriological investigations, etc., to the exclusion of other matters that might be of public interest. Included under this subject, in addition to analytical results, will be found a brief statement of the water-supply service, areas of watersheds, character of service pipe, average consumption, etc.

It has been the policy of the board to make examinations of public water supplies from time to time, for the purpose of detecting any changes that might occur, or any contamination that might take place through any possible channels.

In addition, many private supplies have been examined; also the sources of water supplies depended upon by the railroads of the state. A very complete account of all this work is exhibited in the report of the chemist.

Food and Drug Examination.

A considerable portion of the work done in the laboratory in the examination of foods and drugs has been published from time to time in the *Quarterly Bulletin* of the board, and is not here represented. There will be found, however, a report on Milk Examinations, exclusive of the many examinations that have been made of "inspected milk." (See page 274.) In connection with this subject, attention should be called to the additional requirements necessary to prosecute the work as it ought to be done and to meet public demands along these lines. This subject is forcefully presented in the report referred to.

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Bacteriological Examinations.

A tabulated statement of the work done in this department of the laboratory may be found elsewhere in this volume.

The statistics show that nearly 12,000 examinations were made during the biennial period, more than 8,000 of which were upon specimens submitted by the physicians of the state, for diagnostic purposes chiefly. These figures are exclusive of many water and milk examinations in connection with the chemical examinations of these products.

Inspection Service.

The one inspector employed by the board has been constantly engaged for the past four years in field work, in the inspection of dairies, groceries, bakeries, meat markets, slaughter-houses, alleged local nuisances, etc. A detailed account of his work, which embraces all sections of the state, cannot be included in this report, for the reason already stated.

Special attention has been given to the condition of dairies, the sanitary condition of stables, the methods of handling milk, the facilities for sterilizing milk receptacles and utensils, etc. Dairies are scored in all essential particulars (see page 308) and a copy of the rating is sent to the producer, thus revealing to him most graphically the defects that should be remedied.

In making these inspections, a member of the local board of health accompanies the inspector, in order to familiarize himself with methods and requirements necessary to the production of a clean and wholesome milk. In like manner, groceries, bakeries, restaurants, etc., have been inspected and scored.

In instances of unsanitary conditions, and practices in violation of the law and the regulations, legal notices to remedy defects within a reasonable time limit have been served upon the parties responsible therefor. Marked results in the interests of public health have been secured through such inspection service. Not a few of the most unsanitary conditions have been corrected. A few prosecutions have been made; but the greatest good has been secured through personal instruction and recommendation. The great majority of producers and vendors of food supplies exhibit a gratifying willingness to adopt suggested improvements, and subsequent events have shown the improved conditions to be a good financial investment for the owner.

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In addition to the line of work indicated above, the inspector has accomplished much in sanitary education by giving free public illustrated lectures on public health questions throughout the state. His service to the public has been of incalculable value. The need and the demand for field work of this kind has become so great that another inspector should be provided for. The field is too extensive to be covered by one inspector.

Tuberculosis.

For the purpose of conducting an educational campaign for the restriction and prevention of tuberculosis, the Legislature of 1913 enacted the following:

CHAPTER XVII.

An Act to Aid in the Suppression of Tuberculosis.

Be it enacted by the Senate and House of Representatives in General Court convened:

Section 1. The State Board of Health is authorized and instructed to prepare, or cause to be prepared, such bulletin or bulletins on the cause, restriction and prevention of tuberculosis, embodying such facts, suggestions and regulations as in its judgment shall best instruct the public in methods of prevention and restriction, including the proper sanitary management of said disease.

Sect. 2. It shall be the duty of the board of education of every school district in the state to furnish each teacher of a public school a sufficient number of copies of each bulletin, whenever issued, as to enable the said teacher, whose duty it shall be to distribute one copy to each family represented in said school district.

Sect. 3. The board of education shall ascertain, approximately, the number of copies of said bulletin that may be required under the provisions of the foregoing section and shall report the same to the State Board of Health within thirty days after request is made for same by said State Board of Health.

Sect. 4. The State Board of Health shall, as soon as practicable after ascertaining the number of copies of said bulletin that will be required for the distribution herein provided for, cause to be printed and forwarded to each board of education a sufficient number of copies to meet the requirements of section 2 of this act, and such additional number of copies as in the judgment of the said board may be otherwise profitably distributed.

Sect. 5. This act shall take effect and be in force on and after May 1, 1913.

Approved March 6, 1913.

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Under the provisions of this act, a communication was addressed to the board of education of every town and city in the state, and to the superintendent of every educational institution, asking how many copies of the *Bulletin* on the Restriction and Prevention of Tuberculosis would be required to make a distribution through the schools as required under this law.

Upon receipt of the information asked for, the board transmitted the required number of copies for distribution to every family represented in the schools—approximately 60,000 copies.

An edition of 70,000 copies of the Bulletin was printed to meet other demands, including the mailing of a copy to every family in which there was a case of tuberculosis reported to the board.

Copies were also sent to every physician in the state, to all local boards of health, to clergymen, and to many other individuals.

During the past biennial period 698 cases of tuberculosis were reported by physicians directly to the State Board of Health, under the law requiring confidential returns. This number does not include some cases that were shown to be positive by bacterial examination at the State Laboratory of Hygiene.

It is very evident that not a small number of physicians are ignoring the law which requires the reporting each case of tuberculosis, confidentially, to the State Board of Health. From some localities, no returns have been received; in others, it would appear that the law is being complied with to the letter. There appears to be a total indifference in some quarters of the state to the requirements of the law, the advantage to patients through the reporting of the disease, as well as the protection of the public.

The Reporting of Industrial Diseases.

The Legislature of 1913 enacted a law requiring the reporting of certain occupational diseases and providing for its enforcement. A copy of this law, together with suitable blanks, and a letter calling attention to the requirements of the law, was transmitted to every physician in the state and also to every hospital.

Three cases, only, were reported, as follows:

Place.	Sex.	Age.	Birth.	Occupation.	Diagnosis and symptoms.
Claremont.	M.	30.	Russia.	Finishing shoes.	Nitrobenzene poisoning. Syncope, pallor, cyanosis of lips and fingers, odor of almond oil in perspiration.
Dover.	M.	30.	U. S. A.	Printer (Stereotyper).	Mild lead poisoning. Abdominal cramps almost daily.
Manchester.	M.	45.	Greece.	Painter.	Lead poisoning. Anaemic, blue line on gums, constipation, albuminuria.

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Inspected Milk.

The law, rules and regulations providing for the production and distribution of "Inspected Milk" are elsewhere given in this report. (See page 303).

It will be seen that, without exception, the most sanitary conditions, both in the production and the distribution of the milk, are required. Seventeen dairies have met all the requirements and have been licensed to sell "inspcted milk." Careful supervision is being maintained over these dairies by the State Board of Health. Samples of the milk are taken at frequent intervals for bacterial examination at the State Laboratory of Hygiene, for the purpose of making certain that there is no weak link in the chain of production. The results have been extremely satisfactory, both to the public and to the producers.

In some instances the dairymen have been to considerable expense in fitting up milk rooms, providing facilities for sterilizing bottles and other receptacles, and in making alterations. The testimony of the producers is that there is a public appreciation of clean milk, and that the demand in some localities has been so great as to require an increase in herds. The movement appears to be eminently successful.

Lunacy.

The State Board of Health constitutes a Board of Commissioners of Lunacy. A special report is published, to which reference may be had for details. All commitments, discharges and deaths of insane persons are reported to the board, and a record of every case is kept.

Applications for State Aid for indigent insane persons must be made to the board, and an investigation into the financial standing or resources of the patient is carefully made before such aid is granted.

The following table may be of interest in showing the number of insane persons at the State Hospital and the county institutions at the close of the fiscal year. The law now prohibits the commitment of any insane person to the county almshouses, the few now remaining there being due to the fact that the State Hospital is lacking in facilities to care for them.

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The following shows the number of commitments, discharges, and deaths at the institutions named, during the year ending August 31, 1914, also the number of inmates remaining at these institutions at the latter date, as shown by the records of the board.

Asylums for the Insane.	Inmates September 1, 1914.	Committed during the year ending Aug. 31, 1914.	Discharged.	Deaths.
New Hampshire State Hospital	1,110	366	184	130
Rockingham County Asylum	6	1	3	3
Strafford County Asylum	10	11	1	....
Belknap County Asylum	4	1	2	....
Carroll County Asylum	2	....	....	1
Merrimack County Asylum	....	....	....	....
Hillsborough County Asylum	20	16	6	....
Cheshire County Asylum	17	....	2	....
Sullivan County Asylum	8	1	2	1
Grafton County Asylum	....	....	....	....
Coos County Asylum	1	1	....	....
Total for State	1,178	397	200	135

Sanitary Conference.

During the past year the State Board of Health called a conference of local boards of health to discuss matters relating to public health interests. The session lasted two days and was well attended. Numerous papers were presented and instructive discussions followed.

These conferences are of great value in securing uniformity of action among local boards of health in the management of communicable diseases, the abatement of nuisances, and in dealing with numerous other conditions that confront them from time to time.

Vital Statistics.

The following table gives the number of Births, Marriages, Divorces and Deaths returned for the calendar years 1912 and 1913:

	1912.	Rate per 1,000 population.	1913.	Rate per 1,000 population.
Births	9,133	21.02	9,239	21.17
Marriages	4,104	9.44 (Couples)	4,292	9.83 (Couples)
Divorces	641	1 to 6.4 (Couples)	620	1 to 6.9 (Couples)
Deaths	7,147	16.45	7,475	17.13

A separate statistical report is published and is available to those who desire to study the more intricate features of such returns, and it may be had upon application to the Department of Vital Statistics, Concord.

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Deaths.

Misleading statements have been made in alleging that New Hampshire has the highest death rate of any state in the Union. This statement may be correct with reference to the crude, or actual, death rate; but it is entirely misleading from a sanitary or public health viewpoint.

The crude death rate of a state, while showing the actual mortality, does not afford a reasonable comparison with the mortality of another state unless the population areas are similarly constituted with respect to birth rate, sex, and age groups.

It is apparent to any one that in a population area having a large number of births and a large number of aged people, the mortality must be much larger than in areas with different age distribution. In commenting upon this point, the Federal Bureau of the Census says:

"In some cases the sanitary conditions might be precisely the same, and yet the difference in the crude death rates might lead to the conclusion that one area was much more healthful than the other."

The only way to obtain an exact understanding on this point is to have a standard for comparison—that is, a standard population—and compute the mortality returns from other states and areas upon this standard. The United States government did this for the years 1911 and 1912, and the following table gives the standard, or specific, rates per each one thousand of the population for each of the New England states:

Standard or Specific Death Rate per 1,000 Population.

	1911.	1912.
Maine	13.0	15.5
New Hampshire	14.2	13.6
Vermont	12.6	15.2
Massachusetts	15.0	14.7
Rhode Island	15.7	15.2
Connecticut	14.8	14.2

The only New England States with a specific rate lower than that of New Hampshire in 1911 were Maine and Vermont, while in 1912 New Hampshire had the lowest specific rate of the New England states.

The Census Bureau, in further commenting upon the wrong impression conveyed by the crude death rate, says:

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"For states like Maine, New Hampshire and Vermont, in which are unusually large proportions of persons of more advanced age, the corrected rates are far more representative of the true sanitary conditions, as compared with those of other states, than the crude rates."

The United States Census Report for 1910 shows that New Hampshire has a larger percentage of persons living above 45 years of age than any other New England state.

This brief statement is for the purpose of refuting the inferential allegation that New Hampshire is an unhealthful state.

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WATER SUPPLIES OF TOWNS AND CITIES.

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EXAMINATION OF WATER SUPPLIES.

By Charles D. Howard, Chemist.

Dr. Irving A. Watson, Secretary, State Board of Health:

Dear Sir—The following tabulated matter, with accompanying special reports, represent the work of the laboratory in the examination and control of water supplies for the biennial period ending August 31, 1914.

NUMBER OF EXAMINATIONS.

The summary shows a total of 2,197 samples examined, classified as follows: samples representing regular public supply systems of towns and cities, 710; supplies of semi-public character, inclusive of hotels, industrial establishments, special sources for use on railroad trains, etc., 216; supplies of purely private character, 1,271.

PRIVATE SOURCES.

Comparing the last figure with that recorded two years ago for private sources, viz., 1,221, it will be observed that, notwithstanding a policy in the direction of retrenchment, there has been no actual reduction in the number of private supply examinations. As, however, in connection with the use of the application form, greater discrimination has of late been exercised in the acceptance of samples, it follows that the public demand for such work is on the increase, rather than showing the decrease which was at one time anticipated. Unfortunately, some of this demand is based upon a misconception as to the danger in drinking water, and a certain number of the analyses made are wholly unnecessary. The problem of proper discrimination in such cases, however, is not an easy one.

A NEW LAW GOVERNING THE CONTROL OF PUBLIC WATER SUPPLIES.

A law enacted by the Legislature of 1913 contains the following provisions governing the installation of water supplies:

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"No person, association or corporation proposing to supply water for domestic uses shall construct any new system or enlarge any existing system for supplying water to the citizens of any town or city, without first submitting detailed plans of the proposed construction to the State Board of Health and securing its approval thereof. And it shall be the duty of the said State Board of Health to examine the topography and the water-shed of the proposed supply, and shall also make chemical and bacteriological analyses of the waters of the proposed supply before approval is granted."

Prior to this the acceptance or consent of the State Board of Health was not a requisite in connection with the installation of a public water supply. Occasionally special inspection and advice on the part of the board have been asked. More often it has been the practice merely to forward a sample from the proposed source, and, unless the report thereon was distinctly unfavorable, the sanitary aspects of the matter were not apt to receive any very elaborate consideration by the promoters.

In the smaller communities, where the family wells and springs were still doing fair service in providing drinking water, the furnishing of fire protection was (and still is) a prime consideration in connection with the selection of a water supply; consequently the advice of the expert who was called in was apt to be sought more with regard to such items as "pressure," "head," and "number of available fire-streams."

Because of the comparatively uncontaminated condition of many of our surface waters this method of supply selection has thus far not resulted in the installation of any great number of distinctly poor systems as regards quality. And where supplies of objectionable character have been instituted in the past, this has been due not so often to mistaken judgment on the part of town "water committees" as to considerations of financial expediency on the part of private promoters—conditions under which nothing short of the mandatory power as conferred upon the board by the above act could serve to protect the water consumers.

In some cases supplies originally of good quality have subsequently been rendered inferior or unsafe through the growth of population, or the establishment of manufacturing operations, or because of the largely increased use of the source in question as a summer dwelling or pleasure resort. In New Hampshire espe-

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cially, the rapidly increasing "summer cottage" habit, with the attendant features of boating, bathing and fishing, is yearly becoming a greater menace to the purity of our pond and lake waters. But through the promulgation of sanitary regulations and by other means, steps are constantly being taken to reduce the degree of pollution to the lowest possible minimum.

Thus in the case of the Concord supply, the city has of late made large progress toward purchase of the shores, and a majority of the former cottagers have gone elsewhere. This, and a number of other cities and towns of the state have already adopted the policy of combining municipal ownership of the land bordering the supply with a system of forestation, it being recognized that the conversion of the water-shed into woodland not only has a marked influence in conserving the quantity but is protective of the quality as well.

On the shores of Willand Pond, the source of a portion of the Dover supply, is situated a recreation park serving jointly the cities of Dover and Somersworth. Because of conditions at this pond the city some time ago established a filter plant; recently, as an additional measure of protection, stringent regulations governing sanitary conditions at the park in question have been issued, it having been deemed desirable, because of the nature of the local conditions, to go a step further than customary with such regulations and to apply the provisions of the familiar sidewalk-spitting law to a portion of the park.

Possibly the worst conditions in this conection are to be found at Canobie Lake, the source of Salem's water supply. Yet here, because of the rigid sanitary requirements and the comparatively elaborate precautions observed at the park, as well as for other reasons, the actual danger is probably at least no greater than in the cases of a number of other sources, the shores of which are frequented to a much less degree. In the case of Laconia, the supply of which is physically one of the finest in the state, so critical had conditions become, arising from the above causes, that recently, largely as a precautionary measure, a purification system was installed.

Nevertheless, with all the precautions that it is practicable to enforce relative to the protection of surface water supplies from contamination, it is seldom that one can be absolutely assured at all times and under all circumstances that the water

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which he may drink from such a source is positively free from all disease-producing elements. Although it has long been customary to purify water subject to gross or visible pollution, yet not until recently has much attention been given in this country to the idea of applying such methods of treatment as shall safeguard the consumer against those accidental, occasional and and largely unrecognizable elements of contamination from which scarcely any surface water in inhabited sections is altogether immune. In the more populous countries of Europe it has become a uniform requirement that *all* surface water supplies shall be subjected to some form of purification.

Obviously, the most dangerous variety of pollution is that which involves the discharge into our rivers and lakes of the waste of human existence. A conspicuous instance of a sewage-polluted water supply was that of the Ammonoosuc River at Woodsville, this water, although bearing the sewer discharges of a number of towns above, having been until recently pumped up and delivered to the citizens of the village without any real purification whatever. It is gratifying to be able to state, however, that the condition has lately been remedied.

A number of other towns derive their supplies from sources that are subject to an appreciable degree of pollution, but these supplies are now all submitted to some form of purification. In every case, however, for purposes of fire protection there is a by-pass direct to the distribution mains. In fact, in places where the regular supply is not derived from a contaminated source it is a common arrangement to have an emergency intake in one that is thus polluted.

Doubtless most works superintendents exercise a conscientious avoidance of opening these lines except at times of great emergency. And yet, when there is much shortage of water, as has been conspicuously the case of recent seasons, the temptation to take chances in thus ekeing out the supply must at times be very great. As a protection to the public against such an occurrence a commendable arrangement would seem to be in having a seal placed by the State Board of Health upon these emergency valves, with liability to a penalty for the breaking of such seal without immediate notification of the board.*

*Some legislation along these lines would seem to be desirable. Because of the serious menace sometimes involved in these emergency intakes it would not be unreasonable to require the installation, permanently, of some one of the simple forms of disinfecting apparatus.

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In addition to that from municipal sewage there is always a risk of contamination in the case of the average surface water from such agencies as summer cottages, lumber camps, amusement parks, house-boats, ordinary boating, bathing, fishing, picnic parties, ice-cutting, and from farm privies or cesspools, hogpens and barnyards situated on the water shed. In the case of certain supplies of small volume, extensive adjoining pasturage may readily cause trouble. A case in point is that of the town of Antrim, the supply of which was (for drinking purposes) placed entirely out of commission for a number of weeks as a result of cattle using one end of the small pond as a wallowing place during an unusually dry season. Finally, the practice of cropping too closely to the banks of small streams serving as water supplies introduces an element of contamination—not only through the application of manure but as a result of arsenical insecticides liable to be washed in at times.

OPERATIONS UNDER THE LAW OF 1913.

Under the provisions of this law, before any new supply, or any extension of an old supply can be installed, not only must full plans of such construction be submitted to the State Board of Health, but the latter is obliged to "examine the topography and the watershed of the proposed supply, and shall also make chemical and bacteriological analysis of the waters of the proposed supply" before granting its approval—construction in the absence of the latter being punishable by a heavy fine.

On account of the protracted drouth during 1913, quite a number of towns were compelled to look up additional sources of supply. Also in a few cases new systems have been constructed or have been under contemplation. All of these matters necessitated special investigations on the part of this department, the field inspections having thus far devolved upon the chemist of the board. While it is believed that this represents a valuable line of work and that the time involved has been well spent, yet necessarily such has been at the expense of much which might have been accomplished otherwise in the analysis of foods and drugs and other laboratory operations. In a number of instances sterilization plants, both temporary and permanent, have been installed and these have necessitated careful watching for a

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time through the medium of special examinations—all of which has seriously disturbed the routine of the laboratory as hitherto existing.

Water systems which have made use of chlorination during the past two years, either permanently, or temporarily in connection with emergency intakes, are those of the towns of Berlin, Hampton, Exeter, Lancaster, Franklin, Somersworth, West Lebanon and Woodsville. At Exeter, the primary use of chlorine is not for the purpose of sterilization but to assist flocculation of sediment preliminary to filtration. The installations at Somersworth and Woodsville (both employing liquified chlorine) are for the continuous treatment of the main source of supply. Franklin and Berlin make use of bleaching powder in connection with auxiliary river sources. Hampton has recently completed a new system derived from the famous Marston spring, the latter providing an ample supply of excellent quality for Rye Beach and Little Boar's Head, as well as Hampton Beach.

The West Lebanon division of the Hartford Water Company's supply was augmented during the autumn of 1913 by a spring and by pumping from the Connectivut River in conjunction with mechanical filtration. At this date it has again been found necessary to resort to the river source. It is hoped, however, that by another year a more desirable auxiliary source—plans for which have already been approved—will be available.

The town of Pembroke has recently commenced construction upon a new system having its source in a pond in the town of Deerfield, some thirteen miles distant. Meriden has supplemented its somewhat inferior well supply by mountain brook water of excellent character. Greenville is arranging to install a system from Pratt Pond. The town of Henniker has recently absorbed the property of the Henniker Spring Water Company, the source of the latter—formerly woefully insufficient—having been materially augmented and extended. The village of Haverhill adopted plans during 1913 for the installation of a supply from springs, while the town of Troy, having determined to enjoy the benefits of a public water system, is searching for a suitable supply. Merrimack is to commence construction at once upon a system derived from wells, the water of which is to be filtered, following a process of deferrization. The towns of Wilton and Plymouth

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have also been obliged to consider ways and means of securing an additional supply.

Other special inspections made at various times have been of the supplies of the towns of Somersworth, Derry, Salem, Hudson, Charlestown, Suncook, Dover, Belmont, Lisbon and Concord.

MERRYMEETING POND PROJECT.

Arising from the fact that some of the cities and towns in the southeastern part of the state either had insufficient water, or the supply was of inferior character, a group of persons conceived the idea of establishing a common district supply on a scale such as certain other states now furnish examples. Accordingly, the New Hampshire Water Supply Company was chartered by the legislature of 1913, such company being given the right (providing construction is commenced by May 7, 1915) to furnish water from Merrymeeting Pond, situated in the town of Alton, to the various cities and towns in the district referred to.

As the local conditions about this pond have been found very favorable, and the water has been determined to be of unusual excellence, the plan has been given the approval of this board. Undoubtedly, under proper and satisfactory conditions of service, such a supply would prove of great value to the communities involved. Inasmuch, however, as all of the latter already have local systems of their own, some of which have been established at considerable expense and which under this plan would have to be abandoned, the reluctance in consequence to award service contracts has thus far proved a bar to the success of the enterprise.

WATER AND ICE USED UPON RAILROAD TRAINS.

Under the terms of an order issued during 1913 by the United States Treasury Department, it is incumbent upon railroads and other common carriers to periodically satisfy such department as to the purity of the water and ice provided for passenger use. The certifications as to purity, to be issued by a state or municipal health authority, are based upon the following instructions from the federal department:

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INSTRUCTIONS RELATIVE TO THE CERTIFICATION OF THE WATER AND ICE FURNISHED TO PASSENGERS IN INTERSTATE TRAFFIC.

Samples of water and artificial ice from each and every source of supply should be subjected to bacteriological and chemical examination *at least once in every six months* by the proper state or municipal health authority within whose jurisdiction the supply is obtained, or by other person or persons competent to make such examinations, and whose results will be accepted by the state or municpal health authority whose duty it is to issue certificates. *Each new crop of natural ice should be examined and certified before use.*

The common carrier desiring a certificate of the state or municipal health authority within whose jurisdiction the water or ice is obtained, should make application therefor.

After the necessary examinations shall have been made the certificate should be issued on the above form *in triplicate,* one copy to be delivered to the common carrier, one copy to be forwarded to the Surgeon General, United States Public Health Service, Washington, D. C., and one copy to be retained as a matter of record and for future reference.

Whenever there is an unusual prevalence of typhoid fever, dysentery, infantile diarrhea, or other water-born disease in a locality from which common carriers receive water and ice, an additional examination of the water and ice should be made and a supplemental certificate made by the proper certifying authority and forwarded as above.

Contrary to an idea held in some quarters, the federal department does not make the examinations above called for. Neither is it in any wise compulsory upon a state or municipal department to furnish to the common carrier the inspection provided for under the terms of this order. While the variety of inspection involved is a highly desirable one, there is no reason why, for the sake of mere technical compliance with certain details of the federal order, such a department should burden itself with examinations in cases where it may be in a position to know that these are unnecessary and uncalled for.

In the future, requests for examinations of water and ice supplies as used in passenger service should be taken up with the local health departments, where such water and ice supplies are of public character and regularly subject to inspection at this laboratory. Upon receipt of the certificate of analysis, the local health official will render the desired certification, based upon such analytical report. Where special sources are involved the matter may be taken up directly with this department, although collections should be made by the local health official. In so far

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as practicable, local or topographical inspections will be made of such sources by a representative of the laboratory.

LIST OF RAILROAD WATER AND ICE SOURCES.

Following is a list of sources of water and ice supply used for passenger consumption on interstate trains, as based upon information supplied by the railroads to date. Apparently a number of the smaller stations are missing from this list. With but two or three exceptions, practically all New Hampshire train routes are of interstate character, and in the case of the exceptions the quality of the water is known and is subject to inspection. The Grand Trunk Railway takes no supplies of this nature from New Hampshire sources. Much of that supplied certain other interstate trains is also from out of state sources.

For results of examinations of the supplies here represented, the tabular matter under towns and cities should be consulted.

Station.	Source of Water Supply.	Source of Ice Supply.
†Bartlett	Precinct supply	Sebago Lake, Me.
*Bristol	Bristol Aqueduct Co.	None
*Cherry Mountain	Stream	Davis Pond, Jefferson
*Claremont	Town supply and spring at Jct.	Jones Pond, Claremont Jct.
†Colebrook	Colebrook Water Co.	None
*Concord	City supply	Penacook Lake Ice Co. & Concord Ice Co.
†Coös Junction	Lancaster precinct supply	None
†Crawfords	Stream	None
*Dover	City supply	Cocheco River
‡Fabyans	Spring	Saco Lake
†Glen	Glen Water Co.	None
*Hillsboroough	Town supply	None
†Intervale	North Conway precinct	None
*Jefferson	Mountain spring	None
*Keene	City supply	Keene Ice Company
*Lancaster	Precinct supply	Smith & Howard
†Lancaster	Precinct supply	Sebago Lake, Me.
*Manchester	City supply	Manchester Coal & Ice Co. (Massabesic Lake and Nutt Pond); Maxwell Ice Co. Black Brook).
*Nashua	Pennichuck Water Co.	G. E. Balcom, Sandy Pond and Tarnic Pond

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†North Conway	Precinct supply	None
*North Conway	Precinct supply	G. W. Russell
†North Stratford	Hutchins system	None
*Peterborough	Town supply	None
*Plymouth	Town supply	J. R. Elliott
*Portsmouth	City supply	None
†Quebec Junction	Spring	None
*Rochester	City supply	None
†Sawyer's River	Spring	None
†West Stewartstown	Consolidated Water Co. (springs)	None
†Whitefield	Precinct supply	None
*Wilton	Town supply	None
*Wolfeboro	Town supply	None
*Woodstock (North)	Precinct supply	L. F. Parker

*Supplying Boston & Maine; †supplying Maine Central; ‡joint supply.

All of the above sources of water supply represent water of satisfactory quality, organically, such being in many cases of more than average excellence. In one case, however, that of the Quebec Junction supply, certification was refused because of an excessive proportion of dissolved lead. This source has accordingly been abandoned for public use.

ICE.

During the period represented by this report twenty-nine samples of ice have been examined, seven of which have been reported adversely because of unclean or unattractive character, such being deemed on this account unfit for direct introduction in food or drink, although showing no positive evidence of sewage contamination.

As a rule, there is very little danger of infection from ice as a result of any characteristic inherent in the latter—contrary to the popular idea in this connection. This is due (1) to the well known fact that in the freezing of natural ice under the condition of any considerable depth of water, a process of purification, or separation of the constituents originally present in the water, takes place, the impurities tending to be thrown out of the freezing mass; (2) after ice has been subjected to storage for a few weeks, practically all bacteria of objectionable character perish. Nevertheless, while it is, in consequence of these facts, possible

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to utilize ice from sources, the water of which would not itself be suitable, yet where there is any serious degree of pollution, the direct introduction of such ice into food or drink should not be condoned.

Not infrequently, ice is cut from very shallow ponds, with the result that there is little or no opportunity for purification during freezing, and such ice may in consequence be charged with vegetable and other organic matter. Again, as a result of a rain followed by freezing just preceding harvesting, the product may contain a dirty, more or less discolored streak. Ice harvested from sources in the vicinity of railroads will generally show numerous black specks representing cinders—this being not infrequently the case even when the road-bed is situated at some distance away. Where the railroad skirts the source very closely, so that the latter receives wash from the right-of-way direct, there is liability of serious contamination due to fecal matter discharged from train closets.

By far the best grades of ice are those from which the surface, with its accompanying dirt, etc., has been removed by planing during the process of harvesting. Unfortunately the latter is practiced to but a very limited extent in New Hampshire. It is believed that as a general proposition any elaborate scheme of analysis applied to ice represents a waste of time. The local inspection is important. After that, the chief desideratum is that the ice shall be clear and colorless, melting to a clean liquid. Not only can the householder apply this test for himself, but he should decline to patronize any concern which delivers dirty or cloudy ice. Those companies doing any considerable amount of business will plane their supplies if their patrons will but demand it. In any case, there is no excuse for tolerating dirty ice.

In two or three instances the samples submitted for train use were reported unfavorably because of the defect alluded to. In this connection, however, a fact that needs emphasizing is that cleanliness in the person of the one who fills the water cooler is a much more important object of concern than is the purity of the original source. There is no logic in having frequent examinations of ice where the latter is introduced into the water under the practice prevailing, there being vastly more chance of contracting disease from contact of such ice with the train man's filthy hands than from any inherent impurity. On this account it

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is believed that the present practice on trains and other public places of icing by direct addition to the water should be forbidden. Any one who is inclined to be skeptical on this point need only make a few observations for himself.

Following is a summary of the results of ice examination. The individual results are given under the towns elsewhere:

SUMMARY OF ICE EXAMINATIONS.

Town or City.	No. of Samples.	Passable.
Carroll	4	2
Concord	3	2
Conway	1	1
Claremont	3	0
Dover	1	1
Jefferson	1	1
Lancaster	2	2
Littleton	2	1
Manchester	7	7
Nashua	3	3
North Woodstock	1	1
Woodsville	1	1
Total	29	22

SEWAGE DISPOSAL.

During the 1913 legislative session, the following law was enacted:

In order to maintain the purity of streams, lakes and rivers and to prevent further contamination, no person, association or corporation shall hereafter cause or permit the discharge of sewage or other deleterious waste from any factory, hotel, boarding house, or other commercial establishment into any stream, lake, pond, or river not hitherto polluted without first submitting detailed plans of said proposed discharge to the State Board of Health and securing the approval of the said board.

Whoever violates any of the provisions of this act shall be punished by a fine of not less than one hundred dollars nor more than one thousand dollars.

The matter of sewage disposal is very closely allied to the subject of water supply protection. It is high time that something was done to restrict the promiscuous discharge of human and manufacturing wastes into our public waters. Nevertheless, while the above enactment is a movement in the right direction and

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sounds well, such law is practically of no utility whatever because of the nullifying phrase, "not hitherto polluted."

While unquestionably a wise restriction should be exercised over the matter of sewage disposal, and to this end a law which would really empower the State Board of Health to regulate such disposal is greatly to be desired, still it must not be supposed that there is no danger of going too far in this direction. Although the present day movement, in evidence in all progressive states, to exclude or regulate the entrance of sewage into the public water courses is in every wise commendable, yet there are those who, lacking a conception of the difficulties involved and ignorant of the scientific aspects of the matter, would have the town or city go an unwarrantable distance in this direction.

The present views of sanitary engineers on this subject are well set forth in the following extract from the recent report of a committee of the National Assocation for Preventing the Pollution of Rivers and Waterways:

Because of the increasing population of the country, the increasing tendency toward concentration of population in cities, the extension of agriculture, the increasing necessity of artificial fertilization, and the growth of manufacturing, it is and always will be physically impossible to maintain our rivers and waterways in their original and natural condition of purity. However much we may strive to the contrary, some pollution of the water is inevitable. A reasonable degree of cleanliness should nevertheless be demanded.

Up to certain limiting points the use of our rivers and waterways as vehicles for the reception, transmission, and ultimate disposal of sewage and other liquid wastes is primarily an economic question. The discharge of raw sewage into our streams and harbors should not be universally prohibited by law.

The method of disposal of sewage by dilution is recognized as sound in principle and safe in practice, if carried on with proper restrictions. The power of streams to transport suspended matter and the ability of natural bodies of water to oxidize and destroy offensive substances through the action of various physical, chemical, and biological processes represent a natural resource that should be utilized as far as this can be done with safety and economy and without offense.

Even when the demands of public health, offense to decency, and interference with navigation are such as to place a limit to the pollution of the stream, the economic aspects of the case should be considered in regulating the amount of permissible discharge of waste matter—the fundamental principle being that the results accomplished shall be reasonably commensurate with the cost of prevention of the pollution."

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Sewage may be of two kinds, industrial and domestic, although for our purpose a special classification might be made to include farm and pasture drainage.

In New Hampshire the first named variety of pollution, although of course occurring to a considerable extent in all of the main water-ways, is not as yet a very serious factor in connection with water supply. A conspicuous example is to be found in the discharge of so-called "leather-board" waste, consisting in this case of a mixture of vegetable fibres and oxide of iron, into the Salmon Falls River—a circumstance which has proved a source of considerable annoyance to the Somersworth Water Works department.* Recently, this nuisance has been largely abated through the construction by the manufacturers of large settling basins, which serve to retain much of this waste.

At Derry one of the shoe shops is at the present time discharging large quantities of leather-board into a small brook which, flowing through the heart of the village and subsequently receiving sewage of other character, eventually reaches within a very short distance of the public supply wells. At times of overflow of this brook these sewage matters are prevented from actual flowage in the wells only by the height of the curbs. That such a shiftless and totally unnecessary method of waste disposal should be permanently tolerated seems almost inconceivable.

Other forms of industrial waste include sawdust, spent liquors from bleaching and dyeing establishments, soap-impregnated wash water from laundries, refuse from creameries and slaughter houses, and the resinous and acid liquors from sulphite pulp mills.

METHODS OF SEWAGE DISPOSAL.

At the present time, with two exceptions, our towns and cities have not scrupled to dump their sewage into the public water courses without any purification whatever. Yet, with but little expense, much could be done in the way of improvement. Septic tanks are not an expensive proposition. Even settling basins afford means for material clarification, the resulting effluent, while of course objectionable, being considerably less so than is the original unsettled sewage.

By means of the septic tank a still better effluent is secured, although one, nevertheless, which is putrescible, and so far as its

*See special report on Somersworth supply elsewhere.

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bacterial content is concerned, as highly dangerous as ever to discharge into sources used for water or ice supply. For satisfactory results, a secondary process involving oxidation of the nitrogenous matter is indispensable, and where final discharge into a source of water supply is unavoidable, the effluent from the latter must be subjected to chlorination.

At this date, two towns, Farmington and Wolfeboro, are utilizing the septic process. A large number of septic tanks have, however, recently been installed in connection with hotels, institutions, and private residences. Most of the latter depend for for their efficiency practically altogether upon the anaerobic process. The sewage disposal system at the New Hampshire School for Feeble Minded at Laconia, however, includes a system of sand filtration, which, according to recent analyses, would seem to be capable of excellent work. The surprisingly good results recently noted in connection with some of the smaller tank installations have thus far not been duplicated upon the larger scale. In the latter cases such effluents inevitably carry very large proportions of nitrogenous matter which can only be rendered non-putrescible through oxidation. For such secondary treatment various methods are now in successful use elsewhere.

Following is a general summary of the results of water examinations for the period September 1, 1912—August 31, 1914. Analytical data afforded by supplies of public and semi-public character is tabulated under the individual towns and cities.

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Summary of Examinations, 1912–1914, by Towns.

Town.	Total Public Examinations.	Total Semi-Public Examinations.	Total Private Examinations.	Private Supply Data.				Total Lead Tests.	Total Showing Excessive Lead (0.050+ Parts)	
				Pure.	Pure but for Excessive Lead.	Doubtful or Inferior.	Polluted.		Private Supplies.	Public and Semi-public Supplies.
Acworth	0	0	1	1	0	0	0	1	0	0
Alexandria	0	0	2	0	1	1	0	2	1	0
Allenstown	0	0	1	0	0	1	0	0	0	0
Alstead	0	1	10	4	3	4	0	7	4	0
Alton	2	2	5	1	1	3	1	1	1	0
Amherst	0	1	10	4	0	5	1	4	0	0
Andover	2	0	19	9	1	4	2	11	6	0
Antrim	4	0	4	2	0	1	1	7	2	0
Ashland	2	2	5	3	1	3	1	5	1	0
Atkinson	0	0	1	1	0	0	0	0	0	0
Auburn	0	5	2	0	0	0	2	5	0	0
Barnstead	0	0	4	0	0	2	2	3	2	0
Barrington	0	0	2	0	0	0	2	0	0	0
Bartlett	3	0	1	0	0	1	0	0	0	0
Bath	2	0	0	0	0	0	0	0	0	0
Bedford	0	0	6	1	0	2	3	4	1	0
Belmont	2	0	3	2	0	1	0	0	0	0
Bennington	4	1	2	0	1	1	0	0	0	0
Berlin	48	4	5	2	0	1	2	0	0	0
Bethlehem	3	0	0	0	0	0	0	0	0	0
Boscawen	2	0	2	0	1	0	1	1	1	0
Bow	0	0	6	1	0	3	2	1	0	0
Bradford	0	0	16	7	1	4	3	9	2	0
Bridgewater	0	0	2	1	0	1	0	0	0	0
Bristol	4	0	24	3	5	7	7	15	9	0
Brookline	2	1	1	0	0	1	0	1	0	0
Canaan	2	2	16	3	1	5	7	5	3	1
Campton	0	2	2	0	0	0	0	3	0	1
Candia	2	0	4	7	0	2	1	0	0	0
Canterbury	0	3	5	1	0	2	2	1	0	0
Carroll	0	4	1	1	0	0	0	1	0	1

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Summary of Examinations, 1912–1914, by Towns.—Continued.

Town.	Total Public Examinations.	Total Semi-Public Examinations.	Total Private Examinations.	Private Supply Data.				Total Lead Tests.	Total Showing Excessive Lead (0.050+ Parts.)	
				Pure.	Pure but for Excessive Lead.	Doubtful or Inferior.	Polluted.		Private Supplies.	Public and Semi-public Supplies.
Center Harbor.....	2	9	4	1	0	2	1	1	0	0
Charlestown	9	0	4	1	?	0	0	4	3	0
Chatham	0	0	1	0	0	0	0	1	1	0
Chester	0	2	3	0	0	2	1	2	1	0
Claremont	6	4	11	2	2	6	1	7	2	0
Chichester	0	1	11	2	0	3	5	5	0	0
Colebrook	2	0	1	0	0	1	0	0	0	0
Concord	23	15	38	13	1	12	7	20	6	3
Conway	4	3	11	3	2	4	1	4	2	0
Cornish	0	0	4	1	0	3	0	0	0	0
Croydon	0	0	7	3	0	3	1	1	0	0
Danbury	0	0	14	1	4	3	2	9	8	0
Danville	0	0	1	0	0	0	1	0	0	0
Derry	8	0	4	0	1	1	2	1	1	0
Deerfield	0	0	6	1	0	3	2	3	1	0
Dover	32	0	16	2	0	10	4	1	0	0
Dublin	0	0	10	4	1	2	3	2	1	0
Durham	20	0	9	1	0	3	5	1	0	0
Dunbarton	0	0	7	3	0	2	1	2	0	0
Eaton	0	0	1	1	0	0	0	1	0	0
Elkins	0	0	1	0	0	0	0	1	1	0
Enfield	0	3	4	2	0	1	1	1	0	0
Epping	0	1	3	0	0	0	3	1	0	0
Epsom	0	0	10	0	0	6	4	3	0	0
Exeter	2	1	9	1	0	4	4	1	0	0
Farmington	7	5	12	0	0	7	5	4	0	0
Francestown	2	0	6	2	0	2	1	3	2	0
Fitzwilliam	0	2	27	5	0	9	13	13	1	1
Franklin	28	4	30	11	8	7	5	18	10	0
Franconia	2	0	1	0	0	0	1	2	2	0

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Summary of Examinations, 1912–1914, by Towns.—Continued.

Town.	Total Public Examinations.	Total Semi-Public Examinations.	Total Private Examinations.	Private Supply Data.				Total Lead Tests.	Total Showing Excessive Lead (0.050+ Parts.)	
				Pure.	Pure but for Excessive Lead.	Doubtful or Inferior.	Polluted.		Private Supplies.	Public and Semi-public Supplies.
Freedom	0	2	1	1	0	0	0	2	1	0
Fremont	0	1	0	0	0	0	0	1	0	0
Gilmanton	0	0	2	2	0	0	0	1	0	0
Gilsum	0	0	5	2	0	2	1	5	2	0
Goffstown	3	0	11	1	2	5	3	5	2	0
Gorham	2	0	2	0	0	1	1	1	0	0
Goshen	0	0	5	0	2	2	1	4	4	0
Grafton	0	0	8	2	3	0	0	8	5	0
Grantham	0	0	1	1	0	0	0	0	0	0
Greenfield	0	0	10	1	1	4	4	6	4	0
Greenland	0	0	6	2	0	3	1	1	0	0
Greenville	14	1	11	2	2	6	1	7	3	0
Groton	0	0	0	0	0	0	0	0	0	0
Hampstead	0	0	2	0	0	0	2	0	0	0
Hampton	29	0	21	2	0	6	13	2	0	0
Hampton Falls	0	0	0	0	0	0	0	0	0	0
Hancock	2	0	2	1	0	1	0	2	0	0
Harrisville	0	0	3	1	0	0	1	3	2	0
Hanover	3	0	2	1	1	0	0	2	1	0
Hart's Location	0	1	0	0	0	0	0	0	0	0
Haverhill	16	3	22	3	3	7	1	19	11	3
Hebron	0	0	6	4	2	0	0	3	2	0
Henniker	10	0	5	1	0	0	4	1	1	0
Hill	2	0	4	1	1	1	0	2	2	0
Hillsborough	3	0	12	2	2	4	3	3	5	0
Hinsdale	0	0	7	3	0	3	0	5	1	1
Holderness	0	0	3	0	1	0	1	3	2	0
Hollis	0	0	1	0	1	0	0	0	0	0
Hooksett	0	2	3	2	2	3	1	4	3	0
Hopkinton	2	3	6	1	0	3	0	3	2	0

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Summary of Examinations, 1912–1914, by Towns.—Continued.

Town.	Total Public Examinations.	Total Semi-Public Examinations.	Total Private Examinations.	Private Supply Data.				Total Lead Tests.	Total Showing Excessive Lead (0.050+ Parts.)	
				Pure.	Pure but for Excessive Lead.	Doubtful or Inferior.	Polluted.		Private Supplies.	Public and Semi-public Supplies.
Hudson	13	2	6	0	0	4	2	0	0	0
Jackson	0	3	2	0	0	2	0	0	0	0
Jaffrey	2	1	7	3	0	1	3	2	1	0
Jefferson	0	5	0	0	0	0	0	1	0	0
Keene	12	1	8	5	1	2	2	1	1	0
Kingston	0	0	1	0	0	0	1	1	0	0
Laconia	51	2	23	5	0	5	12	5	1	0
Lancaster	4	0	0	0	0	0	0	0	0	0
Lebanon	37	0	9	4	2	2	0	8	3	0
Lempster	0	0	5	0	2	1	1	5	3	0
Lincoln	2	1	0	0	0	0	0	0	0	0
Lisbon	4	4	4	2	0	2	0	1	0	0
Litchfield	0	0	1	0	1	0	0	1	1	1
Littleton	3	0	4	2	0	2	0	5	1	0
Londonderry	0	3	2	1	0	1	0	2	0	0
Loudon	0	0	5	0	0	4	1	2	0	0
Lyme	2	0	0	0	0	0	0	2	0	0
Lyndeborough	0	0	3	1	1	0	0	3	2	0
Madbury	0	0	0	0	0	0	0	0	0	0
Manchester	26	3	27	3	1	11	9	9	2	1
Marlboro	0	6	18	6	4	5	2	16	5	2
Marlow	0	0	4	1	1	0	2	3	1	0
Mason	0	0	3	1	0	0	2	1	0	0
Meredith	2	5	6	3	0	2	1	2	0	2
Merrimack	5	0	4	2	0	1	1	2	0	0
Milan	0	0	18	1	8	3	0	15	14	0
Milford	8	1	9	0	1	5	2	7	5	0
Milton	0	3	1	0	0	1	0	2	1	1
Monroe	0	0	3	2	0	0	1	3	0	0
Mont Vernon	0	0	2	0	0	0	2	1	0	0

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Summary of Examinations, 1912–1914, by Towns.—Continued.

Town.	Total Public Examinations.	Total Semi-Public Examinations.	Total Private Examinations.	Private Supply Data.				Total Lead Tests.	Total Showing Excessive Lead (0.050+ Parts.)	
				Pure.	Pure but for Excessive Lead.	Doubtful or Inferior.	Polluted.		Private Supplies.	Public and Semi-public Supplies.
Moultonborough	0	4	1	1	0	0	0	1	0	1
Nashua	3	0	5	2	0	0	3	2	1	0
New Boston.....	6	0	9	0	2	2	5	11	2	1
Newbury	0	0	8	7	1	0	0	5	1	0
Newcastle	0	0	2	0	0	0	2	0	0	0
New Durham.....	0	1	5	2	0	1	1	3	1	0
New Hampton.....	2	0	3	1	1	0	0	3	1	0
New Ipswich.....	0	0	8	1	3	2	1	8	5	0
New London.....	1	2	10	2	0	7	1	2	1	0
Newington	0	0	4	0	2	2	0	0	0	0
Newmarket	5	0	3	0	0	0	3	1	0	0
Newport	3	0	12	4	1	5	2	8	2	0
Newton	0	1	7	2	0	1	4	1	0	0
North Hampton.....	0	3	1	1	0	0	0	0	0	0
Northumberland	2	0	3	0	0	0	0	2	2	0
Northwood	0	1	0	0	0	0	0	1	0	1
Nottingham	0	0	2	0	0	0	2	0	0	0
Ossipee	2	6	9	3	1	3	1	3	2	0
Pelham	0	0	0	0	0	0	0	0	0	0
Pembroke	7	1	15	3	1	4	7	2	2	0
Peterborough	5	4	32	13	1	9	3	13	4	1
Pittsfield	2	0	2	1	0	0	1	0	0	0
Plainfield	4	0	6	2	0	3	2	1	0	0
Plaistow	0	0	1	1	0	0	0	0	0	0
Plymouth	6	1	13	4	2	6	1	7	2	0
Portsmouth	3	3	9	3	1	0	5	2	1	0
Quincy	0	0	3	0	1	0	1	2	1	0
Raymond	3	0	0	0	0	0	0	0	0	0
Rindge	0	0	3	0	2	0	1	2	2	0
Rochester	2	3	19	3	0	6	9	7	3	1
Rollinsford	0	10	0	0	0	0	0	1	0	0

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Summary of Examinations, 1913–1914, by Towns.—Continued.

Town.	Total Private Examinations.	Total Semi-Public Examinations.	Total Private Examinations.	Private Supply Data.				Total Lead Tests.	Total showing Excessive Lead (0.050+ Parts.)	
				Pure.	Pure but for Excessive Lead.	Doubtful or Inferior.	Polluted.		Private Supplies.	Public and Semi-public Supplies.
Rumney	0	1	11	5	4	1	0	10	5	0
Rye	0	1	10	1	0	1	7	0	0	0
Salem	2	0	2	1	1	0	0	1	0	0
Salisbury	0	5	6	0	0	3	3	3	1	0
Sanbornton	0	0	2	0	0	1	1	1	1	0
Sandwich	0	3	12	2	0	5	5	3	0	0
Seabrook	0	0	4	2	2	0	0	0	0	0
Somersworth	128	1	15	4	4	7	0	0	0	0
Springfield	0	1	3	2	0	1	0	2	0	0
Stewartstown	1	0	0	0	0	0	0	0	0	0
Stratford	2	0	0	0	0	0	0	0	0	0
Stoddard	0	0	1	1	0	0	0	1	0	0
Strafford	0	1	4	0	0	0	4	2	0	0
Stratham	0	1	2	0	0	2	0	0	0	0
Sunapee	3	1	12	2	1	1	1	2	1	0
Sullivan	0	0	0	0	0	0	0	0	0	0
Sutton	0	3	18	9	2	3	4	9	2	0
Swanzey	0	3	7	3	0	1	3	4	1	0
Tamworth	0	7	5	1	0	3	1	0	0	0
Temple	0	0	1	0	1	0	0	1	0	0
Thornton	0	0	1	0	0	1	0	1	0	0
Tilton	3	0	13	2	1	3	7	4	2	0
Troy	5	4	21	0	1	11	9	18	13	0
Tuftonborough	0	0	3	0	0	1	2	0	0	0
Unity	0	0	1	0	0	0	1	0	0	0
Wakefield	1	3	17	3	1	3	10	7	3	0
Walpole	5	0	7	0	0	3	4	7	1	0
Warner	4	0	22	9	2	5	5	13	5	0
Warren	0	1	10	3	0	3	0	5	5	0
Washington	0	0	6	3	1	2	0	6	2	0
Weare	0	1	6	0	0	4	2	5	2	0

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Summary of Examinations, 1912–1914, by Towns.—Concluded.

Town.	Total Public Examinations.	Total Semi-Public Examinations.	Total Private Examinations.	Private Supply Data.				Total Lead Tests.	Total, Showing Excessive Lead (0.050+ Parts.)	
				Pure.	Pure but for Excessive Lead.	Doubtful or Inferior.	Polluted.		Private Supplies.	Public and Semi-public Supplies.
Webster	0	2	1	0	0	0	1	1	0	0
Wentworth	0	1	16	4	4	3	2	10	7	0
Whitefield	2	0	2	0	0	0	2	0	0	0
Wilmot	0	0	7	4	1	1	1	5	1	0
Wilton	9	1	24	7	4	8	5	18	7	1
Winchester	0	1	9	0	1	3	5	7	1	0
Windham	0	5	3	1	0	2	0	0	0	0
Wolfeboro	2	2	5	1	0	2	2	1	0	0
Woodstock	3	1	6	5	0	0	0	1	1	0
Totals	716	216	1,271	313	402	343	618	632	263	23

Total samples examined, 2,203.

Alstead.

Examination of Water from Spring of C. N. Vilas.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11031	1913 Mar. 31	None	None	Earthy	0.00	.0006	.0016	.005	Ft. tr.	.05	.4	V. h'h	....	0	....

Alton.—The Alton & Alton Bay Water Works Company, established in 1892–93, supplies about one hundred families (90 per cent of the population), with water from a spring, except in dry weather, when it is pumped from Lake Winnipesaukee to a reservoir of 150,000 gallons' capacity.

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Examination of Water from Faucet of Supply of Alton & Alton Bay Water Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10871	1913 Apr. 7	None	V. slight	None	0.25	.0006	.0060	.0050	.0000	.15	1.9	....	....	0	....
12002	1914 Apr. 14	None	V. slight	Sl. Earth	0.15	.0008	.0054	.0050	.0000	.16	1.8	....	....	0	....

Examination of Water from Supply of Clement Inn.

11427	1913 Aug. 13	None	None	None	0.05	.0006	.0010	.0050	.0000	.03	1.2	....	....	0	....

Examination of Water from Wayside Well.

11330	1913 July 29	Heavy opal	Consid. fine	Sl. Earth	0.15	.0040	.0060	.1750	Ft. tr.	.12	1.9	....	....	0	....

Amherst.

Examination of Water from Well of School District No. 2.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11819	1913 Dec. 9	Consid. opal	Consid. earth	Earthy. Arom.	0.05	.0010	.0028	.0500	Tr.	.15	1.4	....	....	0	....

Andover.—The Village Fire District system, supplying 90 per cent of the population, is from a pond fed by a brook and augmented in area through the erection of a dam.

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Examination of Water from Village Fire District System.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10870	1913 Apr. 8	V. slight	V. slight fine	None	0.10	.0026	.0020	.0050	.0000	.11	0.9	....	....	0	0
11986	1914 Apr. 8	V. slight	Sl. veg.	V. sl. marsh	0.15	.0020	.0072	.0050	.0000	.10	1.2	....	....	0	0

Examination of Water from Well Supplying Hotel Potter.

11858	1914 Jan. 1	None	Slight	None	0.05	.0006	.0010	.0050	.0000	.10	1.5	.045	....	0	....

Antrim.—A gravity system installed by the town in 1893 from a pond of about sixteen acres in area. Mains of wood pipe, with iron service pipe. Supplies ninety per cent of the population.

Examination of Water from Tap of Town Supply.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10868	1913 Apr. 7	Slight	V. sl. fine	None	0.15	.0020	.0080	.0050	.0000	.11	0.3	....	....	0	....
11739	Nov. 3	None	None	None	0.07	0005	.0084	.0030	.0000	.13	0.4	....	....	0	....
11887	1914 Feb. 2	Sl. opal	Consid. blk floc.	Mark. veg.	0.25	0280	.0170	.0100	Sl. tr.	.11	0.1	....	....	0	0
11985	Apr. 8	None	Sl. fine	Sl. arom.	0.08	.0100	.0096	.0050	.0000	.12	0.6	....	....	0	0

Ashland.—The public system, owned by the town, is derived from a pond.

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Examination of Water from Tap of Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10866	1913 Apr. 8	Slight	Sl. floc.	V. sl. earth	0.20	.0016	.0050	.0025	.0000	.14	0.3	....	....	0	....
11989	1914 Apr. 9	V. slight	Sl. floc.	Earthy	0.17	.0006	.0061	.0025	.0000	.08	0.3	....	....	0	0

Examination of Water from Well of Batchelder & Webber.

12081	1914 May 6	None	None	None	0.0	.0006	.0010	.0020	.0000	.03	1.9	.040	....	0	....

Examination of Water from Spring owned by State.

12082	1914 May 6	None	V. slight	Sl. earth	0.2	.0006	.0048	.0070	.0000	.17	0.4	....	....	0	....

Auburn.—The analyses representing the supplies of "Island View Farm" and "The Winthrop" indicate a sewage polluted condition.

Examination of Water from Well of T. S. Emery Supplying "The Elms."

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11239	1913 July 23	Sl. opal	V. slight	V. slight	0.05	.0020	.0024	.0300	.0000	.55	1.9	....	....	0	....

Examination of Water from Well of L. Hall Supplying "Pine Bluff."

11290	1913 July 23	None	V. slight	None	0.05	.0006	.0010	.0050	.0000	.10	1 7	....	....	0	....

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Examination of Water from Well of E. P. Tilton Supplying "Island View Farm."

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10c.c.
11291	1913 July 23	None	Sl. floc.	Sl. foul	0.05	.0010	.0010	.3000	.0000	3.45	8.9	....	....	0	....

Examination of Water from Well of G. E. Gilman Supplying "The Winthrop."

11292	1913 July 23	Heavy opal	Consid. fermg.	V. slight foul	0.25	.0010	.0150	.100	V. high	1.10	1.9	....	Consid.	0	....

Examination of Water from Well of Harriett Davis Supplying "Essex Farm."

11293	1913 July 23	Ft. opal	Sl. floc. fermg.	V. slight	0.07	.0020	.0020	.0050	.0000	.25	3.5	....	Consid.	+	....

Bartlett.—The Village Precinct supply is taken from a stream having a watershed of two square miles, wooded and uninhabited.

The Glen Water Company supplies 18 families at Glen from springs (gravity system).

Examination of Water from Tap of Village Precinct System.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10c.c.
11997	1914 Apr. 13	V. slight	None	None	0.07	.0006	.0018	.0050	.0000	.08	0.3	....	....	0	0

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Examination of Water from Tap of Glen Water Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11421	1913 Aug. 12	None	Mod. floc.	None	0.05	.0006	.0024	.0050	.0000	.05	0.4	....	....	0	
12179	1914 June 1	None	Sl. fermg.	None	0.05	.0006	.0024	.0030	.0000	.05	0.1	....	Sl.	0	0

Bath.—The gravity system of the Bath Aqueduct Company has its source in springs.

Examination of Water from Tap of Bath Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10684	1913 Apr. 9	None	Sl. fine	None	0.05	.0006	.0010	.0025	.0000	.08	2.6	....	....	....	....
11987	1914 Apr. 9	None	V. slight	V. slight	0.03	.0008	.0024	.0050	.0000	.07	2.3	....	....	....	....

Belmont.—The town-owned water system consists of a drilled well, two hundred feet, and a number of springs; auxiliary supply from brooks. Water pumped to reservoir of 6,000 gallons; wood mains; one hundred and twenty-five families supplied. (See special report upon the supply.)

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Examination of Water from Tap of Town System.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10867	1913 April 7	V. slight	None	None	0.07	.0010	.0026	.0050	.0000	.11	0.7	....	....	0	0
12106	1914 May 13	None	V. slight	None	0.07	.0006	.0020	.0030	.0000	.13	0.6	....	....	0	+

Bennington.—The supply of the Bennington Water Works Company is from springs; auxiliary stream source.

Examination of Water from Tap of Bennington Water Works Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10647	1912 Dec. 1	V. slight	V. slight	Earthy	0.20	.0010	.0030	.0050	.0000	.07	1.2	....	....	0	....
10887	1913 April 9	V. slight	V. slight	V. sl. veg.	0.07	.0010	.0040	.0050	.0000	.12	0.9	....	....	0	....
11367	Aug. 1	Slight	Sl. earth	V. slight	0.07	.0020	.0030	.0025	.0000	.06	0.9	....	....	0	....
11990	1914 Apr. 9	None	V. slight	V. sl. earth	0.05	.0008	.0024	.0050	.0000	.14	0.7	....	....	0	0

Examination of Water from Spring of Monadnock Paper Mills.

10694	1912 Dec. 30	None	None	Sl. earth	0.07	.0010	.0010	.0050	.0000	.08	1.4	....	....	0	....

Berlin.—There are two private systems, the Berlin Water Company, established in 1892, and the A. B. Forbush supply (1905). The latter consists of springs dug ten feet deep and supplies about twenty families on the east side of the Androscoggin River. (See special report elsewhere on Berlin Water Company's supply.)

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Examination of Water from Berlin Water Company's Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
,526	1912 Oct. 2	V. slight	None	None	0.55	.0010	.0070	.0050	.0000	.13	0.9	....	....	0	....
10,576	Oct. 28	V. slight	V. slight	None	0.55	.0015	.0070	.0025	.0000	.08	0.4	....	....	0	....
10,640	Nov. 26	V. slight	None	None	0.45	.0010	.0080	.0050	.0000	.07	0.4	....	....	0	....
10,712	1913 Jan. 15	V. slight	V. slight	None	0.35	.0010	.0070	.0100	.0000	.12	0.4	....	....	0	....
10,731	Jan. 27	Slight	V. slight	Earthy	0.35	.0040	.0130	.0050	.0000	.12	0.4	...	...	0	....
10,741	Feb. 2	V. slight	Mod, fine	V. sl. marsh	0.55	.0048	.0132	.0050	.0000	.12	0.6	....	....	0	....
0,834	Mar. 24	Slight	None	Sl. earth	0.35	.0010	.0050	.0050	.0000	.13	0.3	...	....	0	....
10,849	Apr. 2	Slight	V. slight	Dist. earthy	0.45	.0010	.0110	.0050	.0000	.12	0.3	....	....	0	....
10,902	Apr. 14	V. slight	Sl. floc.	V. sl. earth	0.40	.0010	.0100	.0050	.0000	.11	0.1	....	....	0	....
11,016	May 15	V. slight	Sl. floc.	Sl. marsh	0.45	.0010	.0070	.0050	.0000	.10	0.4	....	....	0	...
11,118	June 9	V. slight	Slight	None	0.35	.0010	.0094	.0050	.0000	0.10	0.3	....	....	0	....
11,234	July 12	V. slight	V. slight	Mark woody	0.55	.0010	.0096	.0050	.0000	.10	0.1	....	....	+	....
11,239	July 14	Slight	Mod. floc.	Dist. veg.	0.45	.0010	.0170	.0050	.0000	.08	3.2	....	....	+	...
11,259	July 17	Slight	Sl. floc.	None	0.55	.0010	.0086	.0050	.0000	.10	0.4	....	....	0	....
11,281	July 21	V. slight	Sl. floc.	Sl.arom.	0.35	.0010	.0080	.0050	.0000	.10	0.4	....	....	+	....
11,282	July 21	Slight	Consid. brn. floc.	Decay veg.	0.35	.0020	.0110	.0050	.0000	.12	0.3	....	....	0	....
11,300	July 23	V. slight	Sl. brown floc.	Veg.	0.45	.0010	.0100	.0050	.0000	.11	0.1	....	....	0	....
11,325	July 30	Sl. fine	Sl.	None	....	.0010	.0090	.....	.....	....	....	....	....	0	....
11,407	Aug. 12	V. slight	Sl. brown floc.	Sl. wood	....	.....	.....	.....	.....	....	....	....	....	+	...
11,465	Aug. 20	V. slight	V. slight	None	0.25	.0006	,0070	.0025	.0000	.05	1.1	....	....	0	0
1 ,466	Aug. 20	None	V. slight	Slight	0.27	.0006	.0080	.0025	.0000	.05	0.9	..	....	0	0
11,540	Sept. 3	None	Sl. earth	None	0.05	.0006	.0010	.0025	.0000	.04	2.2	....	....	0	....

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Berlin Water Company's Supply.—Concluded.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,541	1913 Sept. 3	Sl. opal	V. slight	None	0.25	.0006	.0010	.0025	.0000	.04	1.6	....	....	0	....
11,665	Oct. 13	None	Slight	V. faint	0.55	.0014	.0144	.0100	.0000	.05	0.3	....	....	0	0
11,740	Nov. 5	None	Sl. floc.	Slight	0.50	.0008	.0108	.0030	.0000	.10	1.1	....	....	0	....
11,820	Dec. 9	None	Sl. brown floc.	None	0.35	.0008	.0084	.0050	.0000	.09	0.1	....	....	0	0
11,928	1914 Mar. 3	V. slight	V. slight	V. slight	0.55	.0010	.0124	.0050	.0000	.08	0.6	....	....	0	+
12,000	Apr. 13	Sl. opal	V. slight	Sl. swamp	0.40	.0010	.0080	.0050	.0000	.07	0.6	....	....	0	0
12,109	May 13	V. slight	Sl. veg.	V. sl. swamp	0.45	.0008	.0078	.0050	.0000	.07	0.6	....	....	+	+
12,160	May 25	V. slight	V. slight	Sw'mpy	0.45	.0022	.0101	.0030	.0000	.07	0.3	....	....	0	0
12,307	June 30	V. slight	V. slight	None	0.45	.0010	.0084	.0030	.0000	.07	0.7	....	....	+	+
12,414	July 27	V. slight	Coarse floc.	None	0.35	.0006	.0086	.0030	.0000	.07	0.4	....	....	0	0
12,523	Aug. 24	Consid.	Consid.	None	0.50	.0010	.0078	.0050	.0000	.10	0.4	....	....	0	0

Examination of Filtered Androscoggin River Water, Supply of Burgess Sulphite Fiber Co.

11,326	1913 July 30	Mod. fine	Sl. fine	Mouldy	....	.0014	.0110	.....	.....	....	....	....	....	0	+
12,361	1914 July 14	Mod. fine	Mod.	Dist. swamp	0.60	.0006	.0114	.0030	.0000	.08	1.2	....	....	0	0

Examination of Water from Spring of E. C. Tarr.

11,620	1913 Sept. 23	V. Slight	Sl. floc.	Decid. veg.	0.10	.0006	.0030	.0050	Ft. trac	15				+	....

Examination of Water from Spring of D. Coffey.

	1913 Nov. 12	Slight	Sl. brown floc.	None	0.30	.0010	.0064	.0050	.0000	.05	1.9	...	...	0	....

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Examination of Water from Spring owned by Harriman Spring Co.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,777	1913 Nov. 16	Sl. opal	None	Sl. earth	0.07	.0010	.0044	.0100	.0000	.03	4.3	....	....	0	....

Examination of Water from Spring of Emile Boisselle (Mt. Carberry Spring Water.)

12,328	1914 July 9	None	None	Earth	0.00	.0006	.0014	.0030	Ft. trac	.23	1.8	....	....	+	+

Examination of Water from Y. M. C. A. Swimming Pool.

12,382	1914 July 14	None	Consid. wh.gelot.	Sl. foul	0.05	.0030	High	.0030	.0000	.20	2.3	....	....	0	0*

*Sample after refiltering, using coagulant.

Results of Bacteriological Examination of Water Submitted from Brook Supplying Reservoirs of Berlin Water Company.

Number	Date of collection	Source	Bacteria per c. c.		Colon Bacilli	
			Agar 37°c	Agar-gelatin 20°c	(1 c. c.)	(10 c. c.)
12,042	1914 Apr. 22	Brook near lumber camp (running water)	15	700	0	+
12,043	Apr. 22	Brook near lumber camp (still water)	60	950	+	+
12 044	Apr. 22	Reservoir No. 2	4	320	0	0
12,045	Apr. 22	Reservoir No. 1, into which brook flows	9	220	0	0
12,203	Jnne 1	Lower reservoir	.....	.....	0	+
12,204	June 1	Upper reservoir	.....	.....	0	+
12,205	June 1	Brook near lumber camp	.....	.....	0	0

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Bacteriological Examination of Water from Androscoggin River—Portion of Supply of Berlin Water Company.

Number	Date of collection	Source	Bacteria per c. c.		Colon Bacilli	
			Agar 37°c	Agar-gelatin 20°c	(1 c. c.)	(10 c. c.)
.....	1913 Sept. 8	River water, raw	1,400	4,700	0	+
.....	Sept. 8	River water, filtered	.....	4,600	0	+
.....	Sept. 8	River water, filtered and treated with bleaching powder	411	16,000*	0	.....
.....	Sept. 22	River water, raw	4,500	10,900	+	.....
.....	Sept. 22	River water, filtered	33	300	0	.....
.....	Sept. 22	River water, filtered and treated with bleaching powder	24	24	0	.....

* Freak result

Bethlehem.—The precinct supply, a gravity system from a stream, furnishes water for 98 per cent of the population.

Examination of Water from Precinct Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,888	1913 Apr. 10	V. slight	Sl. floc	None	0.10	.0010	.0030	.0025	.0000	.05	0.1	....	....	0	....
11,988	1914 Apr. 8	V. slight	V. slight	Dist. earthy	0.2	.0006	.0078	.0025	.0000	.04	0.1	....	...	+	+
12,023	Apr. 15	.....	.....	.....	....	.....	.....	..	.....	....	....	...	..	0	0

Boscawen.—The gravity system supplying Boscawen and a portion of Penacook has its source in a pond of three hundred and forty acres. Mains include some wooden pipe. About two hundred families supplied.

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Examination of Water from Tap of Penacook & Boscawen Water Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,912	1913 Apr. 17	V. slight	Mod. wh. gelot	Sour	0.40	.0010	.0080	.0050	.0000	.13	0.7	....	....	0	....
12,008	1914 Apr. 14	V. slight	V. slight	Dist. earth	0.20	.0010	.0074	.0050	.0000	.09	0.7	....	....	0	0

Bristol.—The Bristol Aqueduct Company supplies water through a gravity system from Newfound Lake to three-fourths of the population. Some lead and tin-lined service pipe.

Examination of Water from Supply of the Bristol Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,883	1913 Apr. 9	V. slight	V. slight fine	None	0.10	.0010	.0050	.0025	.0000	.07	0.4	.000	....	0	....
11,726	Oct. 30	Faint	None	None	0.07	.0006	.0070	.0020	.0000	.08	0.4	....	....	0	...
11,782	Nov. 20	Slight	Sl. veg.	None	0.10	.0010	.0070	.0050	.0000	.07	0.4	...	...	0	....
11,984	1914 Apr. 7	None	V. slight	V. slight marshy	0.10	.0010	.0054	.0050	.0000	.08	0.4	....	....	0	0

Brookline.—A private system from springs, owned by O. D. Fessenden was extended to serve the public in 1912. During 1914 a dug well was added to the system as an auxiliary source.

Neither of the two analyses here given represent water of acceptable quality.

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Examination of Water from Supply of O. D. Fessenden.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11683	1913 Oct. 20	Mod. opal	V. slight	None	0.05	.0014	.0154	.0050	.0000	.12	2.4	.. ..	....	0	[1]
12528	1614 Aug. 25	Heavy opal	V. slight	None	0.03	.0014	.0034	.2750	Consid.	.45	2.9	....	....	+	+[2]

Examination of Water from Stream used by Public.

11372	1913 Aug. 5	Slight	Slight	None	0.30	.0010	.0130	.0050	.0000	.08	0.4	....	....	+	....

[1] Spring water
[2] New dug well

Campton.—Following an examination of water supplying "The Maples," an order was issued directing the removal of the lead pipe in use, the latter being replaced by galvanized iron.

Examination of Water from Spring of J. F. Bedell Supplying "The Maples."

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11387	1913 Aug. 7	None	None	None	0.05	.0006	.0010	.0025	.0000	.04	0.1	.075	....	0	....
11734	Nov. 7	None	None	None	0.00	.0004	.0036	.0030	.0000	.05	1.5	....	....	0	....

Canaan.—Water is supplied by the Crystal Lake Water Company from Crystal Lake (Hart's Pond).

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Examination of Water from Crystal Lake Water Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10799	1913 Mar. 4	Slight	V. slight	None	0.07	.0020	.0060	.0200	.0000	.10	1.1	....	....	0	....
12104	1914 May 12	V. sl. opal	None	Ft. swamp	0.18	.0010	.0084	.0020	.0000	.08	1.1	....	....	0	0

Examination of Water from Spring of Smith & Richardson used by Public.

11002	1913 May 12	V. faint	V. slight	V. sl. marsh	0.15	.0010	.0090	.0050	Ft. tr.	.03	1.2	.050	....	0	....

Examination of Water from Well of W. B. Hinkley Supplying Lucerne Inn.

12360	1914 July 14	V. sl. opal	Slight	Strong arom.	0.05	.0014	.0040	.0030	.0000	.28	3.6	....	....	0	....

Candia.—East Candia is supplied by two private systems, viz., the John A. Holt, from an artesian well, and the J. E. Dearborn, from springs. The latter represents water of good quality. The Holt supply is not satisfactory, the abnormal proportion of nitrates and chlorides, as well as degree of mineralization, being indicative of seepage. No sample from this source was received during the past two years.

Examination of Water from Spring of Jenness Dearborn.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10921	1913 April 18	Sl. opal	Sl. white floc.	Dist. earthy	....	.0010	.0020	.0050	.0000	.20	1.4	.. .	....	0	0
12140	1914 May 21	Sl. opal	Sl. fine	None	...	.0006	.0014	.0600	.0000	.50	1.9	....	....	0	....

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Canterbury.—Examination of wells supplying Pleasant View and the Osgood Farm indicated water unsuitable for drinking purposes.

Examination of Water from Well of L. I Chase Supplying Osgood Farm.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,455	1913 Aug. 15	V. slight	None	None	0.07	.0010	.0060	.4000	.0000	7.00	11.0	....	....	+	....

Examination of Water from Well of E. B. Peverley Supplying Maple Knoll.

11,456	1913 Aug. 15	V. slight opal	Slight floc.	None	0.05	.0006	.0010	0050	.0000	.28	1.9	....	....	0	....

Examination of Water from Well of J. S. Peverley Supplying Pleasant View.

11,457	1913 Aug. 15	None	Slight coarse	Aromatic	0.05	.0034	.0050	.3000	Hi'h	2.95	4.6	...	....	+	....

Carroll.—The following examinations of water and ice represent sources of supply for the Boston & Maine and Maine Central Railroads situated within the town of Carroll. The physical character of ice, sample No. 12,194, cut from Saco Lake, was unsatisfactory.

Examination of Water from Stream Supplying B. & M. R. R. at Twin Mountain.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,963	1913 May 6	None	V. slight	None	0.15	.0006	.0070	.0025	.0000	.05	0.3	....	....	0	....

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Examination of Water from Spring Supplying Maine Central & Boston & Maine Railroads at Fabyan's.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12,046	1914 Apr. 27	V. slight	None	None	0.15	.0020	.0060	.0050	.0000	.04	0.1	....	....	0	....

Examination of Water from Stream Supplying Maine Central Railroad at Crawford's.

12,185	1914 May 28	None	None	None	0.10	.0006	.0020	.0030	.0000	.06	0.1	....	....	0	..

Examination of Water from Spring Supplying Maine Central Railroad at Quebec Junction.

12,257	1914 June 15	None	V. slight	None	0.00	.0010	.0014	.0030	.0000	.05	0.3	.060	....	0	....

Examination of Ice Cut from Saco Lake Supplying Boston & Maine Railroad at Fabyan's.

12,194	1914 June 3	Slt. opal	Sl. coarse veg.	Slight veg.	0.03	.0010	.0034	.0030	.0000	.08	0.00	....	....	0	....
12,252	June 18	Med.	Slight	V. slight	0.00	.0006	.0014	.0030	.0000	.05	0.00	....	....	0	....

Centre Harbor.—The analyses of the supplies of Lakeview Cottage, Mallard Cottage, and the Majestic indicate water of unsatisfactory quality.

Examination of Water from Spring Supply of S. F. Emery.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,084	1913 June 4	None	V. slight coarse	None	0.03	.0010	.0010	.0050	.0000	.12	5.0	....	....	0	..
12,314	1914 July 4	None	V. slight	None	0.03	.0008	.0014	.0050	.0000	.15	5.1	....	...	0	0

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Examination of Water from Wells of Mrs. Adolfo Munoz, Supplying Pinelands, Summer School Camp.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,227	1913 July 10	Mod. opal	V. slight	Slight earth	0.35	.0006	.0030	.0050	.0000	.07	0.9	....	....	0	....
12,299	1914 June 30	Mod. opal	Slight	None	0.40	.0010	.0034	.0030	.0000	.05	1.7	....	....	0	....
12,300	June 30	V. sl. opal	Slight gelot.	None	0.03	.0006	.0010	.0030	.0000	.08	1.9	....	...	0	....
12,301	June 30	V. sl. opal	Slight fine	Slight foul	0.05	.0014	.0088	.0030	.0000	.05	0.7	....	....	0	†

† From Squam Lake

Examination of Water from Spring of R. D. Green Supplying The New Cambridge.

11,337	1913 July 31	Slight opal	V. slight	Slight arom.	0.05	.0020	.0040	.0050	.0000	.20	2.6	....	....	0	....

Examination of Water from Well of M. V. B. Gordon Supplying The Majestic.

11,341	1913 July 31	None	None	None	0.15	.0010	.0016	.2500	.0000	1.80	3.9	.010	....	0	...

Examination of Water from Well of W. B. Mallard, Supplying Mallard Cottage.

11,343	1913 July 31	Mod. opal	Mod. fine	Slight earthy	0.10	.0054	.0070	.2500	Hi'h	1.30	8.9	....	....	0	....

Examination of Water from Well of J. F. Moulton Supplying Lake View Cottage.

11,346	1913 July 31	V. slight	None	None	0.10	.0010	.0050	.225	.0000	.95	5.0	....	....	+	....

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Examination of Water from Sibley Spring used by Kanasatka Inn.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10c. c.
11,347	1913 July 31	None	V. slight	None	0.05	.0006	.0006	.0025	.0000	.05	1.8	....	....	0	....

Examination of Water from D. R. Slade Spring.

11,656	1913 Oct. 8	None	Slight	None	0.05	.0004	.0008	.0025	.0000	.05	1.9	....	....	0	....

Charlestown.—A gravity system from Mill Brook, including two impounding reservoirs, supplies Charlestown village. (See special report concerning this supply.) The supply of North Charlestown is a gravity system from a brook.

Examination of Water from Charlestown Public Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10c. c.
10,869	1913 April 7	None	V. sl. floc	None	0,20	.0010	.0054	.0025	.0000	.10	0.4	....	....	0	....
11,026	May 18	V. slight	Slight	V. slight	0.05	.0014	.0106	.0050	Trace	.09	1.4	....	....	0	....
11,589	Sept. 12	Slight	None	Slight veg.	0.30	.0040	.0124	.0050	.0000	.14	1.5	....	....	0	....
11,601	Sept. 12	Slight	V. slight	V. slight	0.15	0006	.0110	.0050	.0000	.20	3.9	....	....	0	*
11,712	Oct. 25	V. slight	Slight floc	Earthy	0.20	.0030	.0036	.0025	.0000	.19	1.4	....	....	+	+
11,713	Oct. 25	V. slight	Slight floc	Earthy	0.20	.0012	.0078	.0025	.0000	.19	1.4	....	....	+	+
11,714	Oct. 25	V. slight	V. slight	V. slight	0.15	.0010	.0072	.0050	.0000	.23	1.6	....	....	0	+
11,999	1914 April 14	V. sl. opal	None	V. slight	0.15	.0010	.0054	.0100	.0000	.07	0.6	....	....	0	0*
12,182	June 3	None	V. slight	Strong fish	0.15	.0006	.0134	.0030	.0000	.10	2.6	....	....	0	0

* North Charlestown supply

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Chester.—The analysis of the Highland Farm supply indicates a polluted condition.

Examination of Water from Well of A. A. Bean, Supply of Highland Farm.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11294	1913 June 23	None	None	Dist. foul	0.05	.0007	.0084	.5000	.0000	6.70	8.6	....	..	0	....

Examination of Water from Well of Wm. P. Nichols.

12292	1914 June 25	Sl. opal.	Sl. fine	Mark veg.	0.05	.0064	.0024	.007	Tr.	.45	2.3	.010	....	0	....

Examination of Water from Spring owned by B. & A. D. Fessenden.

12326	1914 June 8	V. slight	Sl. silt	None	0.00	.0006	.0016	.225	Ft. tr.	1.80	3.2	....	....	0	....

Claremont.—The town supply is a gravity system from streams off of Green Mountain, wells dug along the bank of the Sugar River constituting an auxiliary source. Some cement-lined iron pipe used in distribution. There are also two private systems from springs (Bible Hill and Grannis systems). Past examinations of the Bible Hill supply have shown lead in dangerous amount. None of the three samples of ice submitted from Claremont were of acceptable quality, all being of too dirty character to be suitable for introduction into drinking water or foods.

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Examination of Water from Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10831	1913 Mar. 24	Slight	V. sl.	Earthy	0.30	.0020	.0104	.0050	.0000	.13	0.6	....	....	0	....
11035	May 19	Sl. fine	V. sl. fine	V. slight	0.10	.0010	.0080	.0050	.0000	.11	0.9	....	....	0	....
11322	July 29	None	None	None	0.15	.0010	.0020	.0050	.0000	.28	1.8	....	*	0	....
11547	Aug. 3	V. sl. opal	Slight	None	0.15	.0020	.0050	.0050	.0000	.26	1.6	....	*	0	....
11942	1914 Mar. 12	None	V. slight	Sl. arom.	0.10	.0010	.0080	.0050	.0000	.14	1.6	....	....	0	0
12271	June 24	Sl. opal	Slight	Sl. foul	0.07	.0032	.0080	.0030	.0000	.15	1.5	....	....	0	0

*Wells on Kelsey's Island.

Examination of Water from Spring used by Railroad.

10865	1913 Apr. 4	V. slight	V. slight	None	0.05	.0006	.0020	.0050	.0000	.05	3.7	....	....	0	0

Examination of Water from Spring Supplying Stone Watering Trough.

11631	1913 Sept. 25	None	None	None	0.05	.0008	.0010	.0100	.0000	.20	4.6	....	....	+	.. .

Examination of Water from Jones's Spring used to Supply Passenger Cars at Claremont Junction.

12144	1915 May 18	None	None	None	0.00	.0010	.0018	.0030	.0000	.05	0.6	....	....	0	....

Examination of Ice Used by Railroad (cut from pond near station at Claremont Junction).

10876	1913 Apr. 4	Slight	Consid. bl. floc.	Mark. earth	0.08	.0010	.0070	.0025	.0000	.02	0.00	....	....	0	....

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Examination of Ice from Sugar River, Supply of Claremont Ice Co.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c.c.	10c.c.
11162	1913 June 9	Mod. opal	Consid. white	Strong arom.	0.05	.0010	.0120	.0050	.0000	.03	0.00	....	....	0	....

Examination of Ice from Jones's Pond, Supply Boston & Maine Railroad.

12148	1914 May 25	Slight	Mod. bl. floc.	Slight	0.05	.0014	0.064	.0030	.0000	.06	0.00	....	....	0	....

Examination of Water from Spring of Edmunds & Frost, used by Public.

10660	1912 Dec. 5	Faint	V. sl.	None	0.00	.0005	.0005	0025	.0000	.05	4.2	.030	....	0	....
10989	1913 May 8	V. sl.	Sl. floc.	Sl. foul	0.05	.0026	.0030	.0050	.0000	.08	4.3	.020	....	0	....

Examination of Spring of Mrs. L. T. Moody, used by Public.

12545	1914 Aug. 31	None	None	None	0.03	.0014	.0020	.0050	.0000	.35	1.9	.060	..	0	...

Colebrook.—There are two private systems, the J. E. Lombard Water Works, supplying about forty families with water from springs, and the Colebrook Water Company, which constitutes the principal supply. The source of the latter is a stream and springs.

Examination of Water from Colebrook Water Company's Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c.c.	10c.c.
10903	1913 Apr. 21	V. slight	None	None	0.35	.0006	.0090	.0025	.0000	.09	2.2	....	....	0	....
12056	1914 Apr. 28	None	V. slight	None	0.45	.0006	.0040	.0050	.0000	.04	1.8	....	....	0	0

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Concord.—The city supply is derived from Lake Penacook. (See special report elsewhere.)

Examination of Water from City Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10804	1913 Mar. 7	V. slight	V. slight	V. sl. earth	0.03	.0006	.0070	.0025	.0000	.11	.04	....	....	0	. ..
10955	Apr. 30	.....	.....	.....	....	.....	.....	.....	.....	....	....	[1]	....	....	....
11076	May 26	.....	.....	.....	....	....	.....	.....	.....	...	. .	.040	....	....	....
11058	May 27	V. slight	Sl. fine	Dist. veg.	0.15	.0014	.0070	.0050	.0000	.10	0.1	....	....	0	....
11503	Aug 26	V. slight	Sl. fine veg.	Sl. musty	0.05	.0020	.0130	.0050	.0000	.10	0.3	....	....	0	....
11822	Dec. 13	V. sl. opal	V. slight	V. sl. marsh	0.03	.0008	.0074	.0050	.0000	.14	0.7	....	....	0	0
11932	1914 Mar. 9	Sl. opal	V. slight	Sl. veg.	0.12	.0024	.0094	.0030	.0000	.17	0.7	....	....	0	0[2]
11946	Mar. 12	Sl. opal	V. slight	V. slight	0.13	.0020	.0138	.0050	.0000	.23	0.4	....	....	0	0[3]
12090	May 9	Mod. fine	Consid. floc. earth	Earthy veg.	0.15	.0012	.0074	.0030	.0000	.15	0.4	....	....	0	0
12131	May 19	Slight	Sl. fine	Sl. swamp	0.05	.0010	.0106	.0030	.0000	.14	0.4	....	....	0	+
12132	May 19	Slight	Sl. fine	Sl. swamp	0.05	.0010	.0094	.0030	.0000	.14	0.4	....	....	0	0
12133	May 19	Slight	Sl. fine	Fishy	0.05	.0008	.0098	.0030	.0000	.14	0.4	....	....	0	+
12134	May 19	V. slight	Sl. fine	Swampy	0.05	.0010	.0094	.0030	.0000	.18	0.4	....	....	0	+
12135	May 19	V. sl. opal	V. slight	V. sl. fishy	0.05	.0008	.0094	.0030	.0000	.14	0.4	....	....	0	+
12141	May 22	None	Sl. floc.	Dist. veg.	0.05	.0010	.0104	.0030	.0000	.13	0.4	.050	....	0	+
12202	June 8	.....	.....	.....	....	.....	.....	.....	.....	....	....	.035	....	....	....
12216	June 10	V. sl.	Brown floc.	Earthy	0.03	.0006	.0092	.0030	.0000	.13	0.4	.055	....	0	0
12381	July 17	.....	.....	.....	....	.....	.....	.....	.....	....	....	.100	....	....	....
12508	Aug. 7	Slight	Sl. brown floc.	Earthy	0.05	.0006	.0092	.....	.0000	.20	0.7	.002	....	+	+
12521	Aug. 24	Consid. fine	Consid. fine	Dist. grassy	0.10	.0006	.0076	.0050	.0000	.13	0.4	....	....	0	+

[1] Much lead carbonate in suspension. From private tap, much lead pipe in house.
[2] Contained bacteria per cc.: 9 at 37°; 960 at 20°
[3] Collected from lake just beneath ice, Contained bacteria per cc.: 19 at 37°; 20 at 20°

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Examination of Water from Turtle Pond.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11703	1913 Oct. 24	Mod.	Mod. fine veg.	Slight	1.10	.0010	0194	.0100	Ft. tr.	.04	1.1	....	...	0	....

Examination of Water from Springs of Geo. O. Robinson, East Concord, known as Crystal Spring.

10,759	1913 Feb. 17	None	None	None	0.00	.0008	.0008	.0025	.0000	1.33	3.5	....	....	0	[1]
10,769	Feb. 21	.....	.....	.....	....	.....	.....	.....	.....	1.35	3.7	....	....	0	[*1]
10,862	Apr. 3	None	V. slight	None	0.05	.0006	.0010	.0350	.0000	1.30	2.7	....	....	0	[2]
10,863	Apr. 3	V. slight	V. slight	None	0.00	.0006	.0008	.0050	.0000	.25	0.3	....	....	0	[3]
10,892	Apr. 11	None	None	None	0.05	.0006	0010	.0200	.0000	1.40	3.2	.. .	...	0	†
11,931	1914 Mar. 7	None	V. slight	None	0.03	.0008	.0018	.550	.0000	1.31	3.6	....	....	0	‡[1]
11.947	Mar. 12	None	None	None	0.02	.....	.....	.575	.....	1.34	3.7	....	...	0	‡[1]

[1] From bottle as supplied by distributor.
[2] Sample taken from large spring near railroad.
[3] Sample taken from spring in woods.
* Contained 20,000 bacteria per c. c. at 37°c.
† Contained 420 bacteria per c. c. at 37°c
‡ Each contained one bacterium per c. c. at 37°c.

Examination of Water from Well of Concord Gun Club.

11,438	1913 Aug. 15	Heavy opal	Con. fine	Earthy	0.35	.0010	.0030	.0100	Hi'h	.25	5.3	...	....	0	....

Examination of Water from Spring of Concord Electric Co.

11,341	1913 Dec. 31	None	V. slight	None	0.03	.0006	.0014	.0050	V.ft. trac	.30	1.9	....	....	0	....

Examination of Water from Spring at State Prison.

10,753	1913 Feb. 13	None	None	None	0.00	.0006	.0006	.0025	.0000	.18	0.1	....	..	0	....

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Examination of Water from Well at Penacook Lake Park.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,057	1913 May 27	None	Sl. fine	None	0.03	.0010	.0136	.0100	.0000	.40	1.2	....	....	0	....

Examination of Water from Sugar Ball Pond, East Concord.

11,736	1913 Nov. 4	Slight	Mod. floc.	None	0.03	.0010	.0054	.0030	.0000	.20	0.6	....	...	0	....

Examination of Water from Well at Pineholm, Supply of Friendly Club.

12,274	1914 June 23	Heavy	Heavy brown	V. mark veg.	1.60	.0006	.0200	.0030	.0000	.25	1.7	....	....	0	....
12.519	Aug. 21	Mod.	Consid. br. floc.	Extreme veg.	0.30	.0156	.0202	.0050	.0000	.95	1.6	....	....	+	....

Examination of Water from Well of Kearsarge Club.

12,462	1914 Aug. 11	Mod.	Consid. floc.	Earthy	0.20	.0014	.0030	.0050	.0000	.08	1.5	. ..	Consid.	9	....

Examination of Ice from Horse Shoe Pond, Supplied to Boston & Maine Railroad.

10,838	1913 Mar. 31	Slight	Consid. coarse veg.	Earthy	0.05	.0040	.0034	.0025	.0000	.03	0.0	....	....	0	....

Examination of Ice from Fort Eddy Pond, Supplied to Boston & Maine Railroad.

10,839	1913 Mar. 31	Slight	Sl. black	V. sl. earth	0.05	.0046	.0086	.0025	.0000	.02	0.0	....	....	0	....
12,087	1914 May 7	None	Slight	None	0.02	.0020	.0028	.0030	.0000	.03	0.0	....	....	0	0

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Conway.—Conway village supply (Conway Aqueduct Company) is from springs.

The villages of North Conway, Intervale and Kearsarge are furnished by the North Conway Water and Improvement Company with water from mountain brooks off Hurricane Mountain, there being three storage reservoirs.

Examination of Water from Faucet of Conway Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,461	1912 Sept. 5	None	None	None	0.0	.0005	.0005	.0025	.0000	.05	0.1	....	....	0	....
11,191	1913 June 25	Mod. opal	Heavy brown floc	Foul	0.25	.0090	.0090	.0200	.0000	.07	0.3	....	....	0	0a

a. Taken from dead end of main.

Examination of Water from North Conway Precinct.

10,945	1913 April 28	V. slight	V. slight	Sl. earth	0.10	.0006	.0016	.0050	.0000	.04	0.1	....	....	0	....
12,068	1914 May 4	None	V. slight	V. slight	0.0	.0010	.0022	.0030	.0000	.03	0.1	....	....	0	0

Examination of Water from Pond from which is cut Ice Supply of Conway.

10,716	1913 Jan. 19	V. sl. opal	V. slight	Marshy	0.25	.0020	.0100	.0050	.0000	.05	0.1	....	....	+	....

Examination of Water from Well of A. E. H. Brooks, Supply of Echo Farm.

11,410	1913 Aug. 13	Slight opal	Mod. fine	Sl. marsh	0.05	.0006	.0010	.0050	.0000	.07	2.7	....	....	0	....

Examination of Water from Stream, Supply of Lacey Farm.

11,422	1913 Aug. 12	None	None	Sl. slate	0.15	.0006	.0030	.0050	.0000	.05	0.1	....	....	0	....

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Examination of Ice from Echo Lake, Supply of Boston & Maine Railroad.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,875	1913 April 8	V. slight	V. slight	Mouldy	0.05	.0010	.0010	.0025	.0000	.03	0.0	...	....	0	....

Derry.—The town supply is taken from a series of wells, the water being pumped to a standpipe of 180,000 gallons capacity. (See special report elsewhere.)

Examination of Water from Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,788	1913 Mar. 5	Slight	Slight	Sl. earth	0.07	.0010	.0015	.0150	.0000	1.40	8.2	....	....	0	...
11,075	May 29	None	V. slight	None	0.05	.0015	.0020	.0250	.0000	1.05	8.5	....	....	0	....
12,001	1914 April 14	None	Mod. earth	None	0.02	.0010	.0034	.0850	.0000	1.02	2.9	....	....	0	0
12,055	April 29	None	V. slight	None	0.03	.0010	.0030	.1000	.0000	1.01	2.9	....	....	0	0

Examination of Samples of Water collected from Horne and Beaver Brooks at various points.

11,154	1913 June 18	V. slight	Mod. floc.	Earth arom.	0.08	.0010	.0034	.0100	.0000	.27	1.2	...	....	0	+[1]
11,155	June 18	V. slight	Mod. gelot.	Leather	1.40	.0020	.0290	.0100	.0000	.27	0.7	....	.. .	+	+[2]
11,156	June 18	Heavy	Heavy gelot.	Mark foul	2.00	.0024	.0410	.0150	.0000	.65	1.9	....	...	+	+[3]
11,157	June 18	Slight	Mod. br. floc.	Arom.	0.45	.0026	.0190	.0100	.0000	.25	1.1	...	....	+	+[4]

[1] Horne Brook, above pond.
[2] Horne Brook, at dam above leather-board mill
[3] Horne Brook, near lumber mill.
[4] Beaver Brook, at emergency intake.

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Examination of Water from Well of Mrs. F. W. Tinker, Supplying Beaver Lake House.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,142	1913 June 17	None	None	Dist. veg.	0.08	.0040	.0050	4.500	V'ry high	21.50	51.5	....	....	0	0

Dover.—During 1908–09 the city of Dover installed a covered slow sand filter, consisting of two beds each of 0.2 acre net area. The raw water consists of a mixture of about 400,000 gallons daily pumped from Willand Pond, together with from 100,000 to 200,000 gallons from Hussey Springs by gravity flow. The latter water is impregnated by iron, some of which settles out in the settling basin from the aërator, the balance going on to the filters, where it is retained at the surface as a very compact red mud. The process is effective in removing all but unobjectionable traces of the iron, although the water of certain individual springs is so highly ferruginated that it cannot be utilized without rapidly overburdening the filters.

The superintendent states that it is the practice to rake the surface of the filters at intervals of three weeks, an inch of such surface being cleared off and rejected (not washed) four or five times annually, this sand being replaced by new, following a removal of six or eight inches. Notwithstanding the greater burden of suspended matter placed upon them, these filters work at a higher rate than at Somersworth.

Recent bacterial counts made on the Dover water supply have revealed a remarkable and unexpected circumstance. As previously stated, this water consists of a mixture in varying proportions of Willand Pond water with a spring water that is highly charged with iron and is at times acid in character. The pond water, pumped during twelve hours of the day, and constituting the larger volume, enters a twelve-inch gravity line from the springs, the distance from the point of mingling to the discharge at the aërator pipe being 3,400 feet. After leaving the settling

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chamber following aëration, the water passes through the filters to the receiving basin, at which point the volume is augmented by about 100,000 gallons representing the discharge of two 300-feet artesian wells. The table on page 52 shows the bacterial content of this water, also its reaction to acid and alkali, cold and after boiling, using two indicators.

Notwithstanding that the larger part of the supply comes from a surface source containing the number of bacteria usually found in any water of this class, yet it appears from the above data that as a result of mixing with the springs supply, the water as discharged from the main into the aërating chamber and *before filtration*, is nearly sterile. So far as the results indicate, the mixed water, before reaching the filter-bed, contains less than one per cent of the bacteria originally present in the pond supply. Obviously, this is due to some influence wielded by the springs water apart from mere dilution. It can scarcely be attributable in any marked degree to the mechanical agency involved in flocculation of the iron, because during the comparatively rapid course of the water through the main, there is little opportunity for sedimentation, and in the laboratory examination the floccules are thoroughly disintegrated before plating. Neither is the existence of a trace of acidity of itself a plausible explanation. The conclusion seems justified that the iron present plays the role of a disinfectant—this notwithstanding that iron salts, even in moderately strong solution, are not accredited with the possession of any very notable disinfecting qualities.

It is possible that the form of combination may have some influence in this connection. It seems improbable that the iron originally present exists altogether as simple bicarbonate. Not only is there no extensive precipitation of iron noticeable at the

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Results of Examination of Dover Water Supply for Bacteria and Acidity.

Date (1913)	Source	Bacteria per c. c.		B. coli (1 c. c.)	Reaction of 100 c. c. with $\frac{N}{50}$ neutralizer, using:		
					Methyl Orange	Phenolphthalein	
		at 37° C	at 20° C			Cold	After boiling
Sept. 15	*Aërator pipe (pond and springs water)	3	20	Negative	.....	.....	.....
	*Settling chamber.....	3	19	Negative	.....	.....	.....
	†Receiving basin (filtered)	1	3	Negative	.....	.....	.....
	† " " "	0	9	Negative	.....	.....	.....
Oct. 7	*Aërator pipe.....	1	10	Negative	alkaline	0.50 acidity	.....
	*Settling chamber.....	0	0	Negative	alkaline	0.35 acidity	.....
	†Receiving basin.....	1	7	Negative	alkaline	1.90 acidity	.....
	† " "	1	7	Negative	alkaline	1.90 acidity	.....
Oct. 14	*Aërator pipe.....	1	3	Negative	1.30 alk.	0.80 acidity	Faintly alk.
	*Settling chamber.....	0	10	Negative	0.80 alk.	0.50 acidity	Faintly alk.
	†Receiving basin.....	2	17	Negative	0.40 alk.	1.00 acidity	0.90 *acidity*
	†Tap, main pump station	1	20	Negative	0.30 alk.	0.90 acidity	0.80 *acidity*
Oct. 16	‡Willand pond.....	85	2700	Doubtful	0.90 alk.	0.20 acidity	Faintly alk.
	*Aërator pipe	1	21	Negative	0.90 alk.	0.50 acidity	Faintly alk.
	†Receiving basin.....	1	4	Negative	0.40 alk.	0.60 acidity	0.40 *acidity*
	†Tap, city building... ...	3	9	Negative	0.30 alk.	0.80 acidity	0.80 *acidity*
Oct. 22	‡Willand pond.....	26	3000	Positive	0.70 alk.	0.20 acidity	Faintly alk.
	*Aërator pipe.....	4	12	Negative	0.80 alk.	1.10 acidity	0.10 *acidity*
	†Receiving basin.....	1	9	Negative	0.35 alk.	0.60 acidity	0.40 *acidity*
	†Tap, city building.....	3	20	Negative	0.20 alk.	0.80 acidity	0.80 *acidity*

*Consists of *unfiltered* mixture of pond and springs water.
†Pond and springs water after filtering, together with some artesian-well water.
‡Includes no springs water.

springs themselves, but some recent experiments tend to show that the iron in the original water is not very readily precipitated by aëration alone. Nevertheless, on mixing with the pond water such precipitation commences immediately, it being noted that such is already well advanced at the moment of discharge from the main into the aërating chamber.

The table on page 54 contains the results of some chemical examinations. From the reaction data appearing in the two tables, it does not appear that the acidity is due merely to the presence of iron salt. On the contrary, as is evident from the results presented, such acidity seems to develop in the filtered water from which the iron has been separated, being apparently due to some decomposition process resulting in the formation of a non-volatile acid of organic character. Whether such was originally in combination with the iron, or represents an independent

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by-product generated from the dissolved peaty matter, has not been determined. While it is claimed that the acidic character is most noticeable following a rainy period, yet this peculiarity is so very erratic in its manifestations that no definite hypothesis concerning its mode of development is advanced.

As a rule, the unfiltered water is alkaline to methyl orange, but the degree of such alkalinity tends to approach the neutral point as a result of filtration and standing in the mains. Although most of the phenol phthalein acidity before aëration seems to be due to free carbonic acid merely, yet it is noticeable that the water later develops a variety of acidity to phenol phthalein that is not discharged by boiling.

While there has been some corrosion of the mains, the principal complaint coming to our attention has been in connection with "hardness," and the action upon hot water tanks, the dissolved copper causing the water to turn blue with soap. Obviously, the use of lead pipe with water of this character is to be especially avoided.

Yet, notwithstanding its somewhat unusual character and the rather fearsome suggestiveness contained in its action upon pipe, there is no good ground for claiming that the use of this water is likely to prove deleterious to health. Free carbonic acid, present in some degree in all water, has a well defined corrosive action upon metals, yet when ingested by the human system, its effects are regarded as beneficial.

As previously stated, the acid character here discussed is not constant, being dependent partly upon the use of certain individual units of the springs supply, partly upon seasonal conditions. It seems probable, however, that the application of an alkaline treatment would be advisable at times, although a better remedy would be in planning the abandonment of all but the best of the springs supply, in selecting the additional source which the increased needs of the city will render eventually necessary.

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Results of Chemical Examination of Dover Water Supply, Showing Content of Iron and Acidity.

(Except where indicated, samples represent varying mixtures of pond and springs water with some artesian-well water)

(Parts in 100,000)

Date of collection	Source	Residue		Ammonia		Chlorine	Hardness	Iron	Reaction of 100 c. c. with $\frac{N}{50}$ neutralizer, using:		
		Total	Fixed	Free	Albuminoid				Methyl Orange	Phenolphthalein	
										Cold	After Boiling
1909											
Dec. 22	Receiving basin (filtered)	8.5	6.0	.0020	.0070	.55	3.9	.....	1.10 *acidity*	.....	.....
	Tap, City building	12.5	9 0	0025	.0040	.55	4.7	*	0.50 alk.	.....	.....
1910											
Jan. 2†	Receiving basin (filtered)	6.0	4.0	.0045	.0025	.60	1.9	trace	alkaline	.....	.....
April 15	Receiving basin (filtered)	16.2	9.9	.0312	.0054	.79	9.3	.068	3.00 *acidity*	21.0 acidity	20.00 *acid.*
	Aërator pipe (unfiltered)	19.8	11.1	.0310	.0088	.91	9.3	1.600	2.50 *acidity*	28.00 acid.	25.00 *acid.*
	Cold water tap, 56 Atkinson St.)	9.7	7.2	.0004	high	.74	4.4	.035	0.30 *acidity*	9.00 acidity	9.00 *acidity*
	Hot water tap, 56 Atkinson St.)	11.1	8.3	.0012	.0120	.66	5.7	0.40†	0.30 *acidity*	7.00 acidity	7.00 *acidity*
1911											
Nov. 9	Tap, City building	6.9	6.0	.0010	.0015	.44	2.6	.020	1.10 alk.	.....	.....
	Receiving basin (filtered)	7.5	5.0	.0015	.0915	.42	2.7	.015	1.00 alk.	.....	.....
	Tap in City.....	7.0	5.5	.0020	.0015	.42	2.6	.020	1.10 alk.	.....	.....
1912											
Aug. 3	Hussey well, (iron springs, no pond water)	7 0	6.2	.0110	.0010	.75	2.0	much	.....	.....	.....
1913											
Jan. 2	Receiving basin (filtered)	13.1	11.0	.0012	V. high	.65	5.0	.010	0.70 *acidity*	3.50 acidity	3.30 *acidity*
July 10	Aërator pipe....	....	....	.0100	.0030	.65	2.0	.450	1.20 alk.	1.20 acidity	Ftly. alk.
	Receiving basin (filtered)	....	....	.0020	.0080	.50	1.5	.025	1.00 alk.	0.10 acidity	Ftly. alk.
Oct. 22	‡Willand pond (no spring water)	4.2	3.2	.0030	.0164	.45	1.2	.015	0.80 alk.	0.20 acidity	Ftly. alk.
	§Hussey well, (no pond water)	6.3	5.0	.0024	.0094	.50	1.5	.350	0.50 alk.	1.50 acidity	0.40 *acidity*
	‖Aërator pipe (pond; and springs)	7.8	6.5	.0020	.0084	.50	2.2	.200	0.70 alk.	1.50 acidity	0.20 *acidity*
Oct. 27	Welch school (dead end)	....	....	.0010	.0056	.55	3.6	1.200	1.60 alk.	0.50 *alk.*	0.50 alk.

*0.8 part zinc, apparently taken up from pipe by earlier acid condition at this date
†Water turned blue with soap; contained distinct trace of copper
‡Contained sulphuric anhydride, 1.13 parts
§Contained sulphuric anhydride, 1.24 parts
‖Pond water pump just started. Apparently consists largely of springs water

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Ragnor Brook, North of County Farm Road.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11253	1913 July 17	Consid.	Consid. floc.	None	0.45	.0020	.0070	.005	.0000	.25	1.4	....	.040	0	....

Kelly Spring Supply, Bubble Fountain, Locust St.

11135	1913 June 10	Consid. opal	Consid. ferrug	None	0.45	.0010	.0080	.005	.0000	.15	0.3	....	.250	0	....

Main Public Supply System, at Dead End.

11684	1913 Oct. 17	Sl. opal	None	None	0.15	.0010	.0050	.010	.0000	.50	2.6	....	....	0	....

Upper Section, Willand Pond, near Driving Park.

11378	1913 Aug. 5	Slight	Mod. floc.	Sl. disagr.	0.40	.0020	.0150	.010	.0000	.30	1.1	....	.040	0	+

Cocheco River at Horne's Hill.

11735	1913 Nov. 3	Slight	Consid. floc.	Sl. veg.	0.60	.0044	.0192	.003	.0000	.50	1.2	....	.060	+	+

Ice Supplied B. & M. R. R. by Dover Ice Company, cut from Cocheco River.

12259	1914 June 6	Consid. opal	Mod. bl. floc.	None	0.00	.0010	.0024	.003	.0000	.05	0.0	....	....	0	....

Durham.—Water is furnished to the college and to the village from four systems. The principal supply, known as the Durham Spring Water Company (Pettee supply), consists of five dug and drilled wells, the water of which is pumped to a standpipe of 7,000 gallons capacity. One mile of distributing mains; about one half of the village, is supplied from this source.

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The New Hampshire College of Agriculture and Mechanic Arts is supplied by a drilled well 265 feet deep, with a capacity of 40 gallons per minute. Water from the well, and in emergency from a pond, is pumped into a standpipe of 10,000 gallons capacity. There is about one half mile of distributing mains.

The Durham Water Works (Burnham system) now buys water from the private deep drilled well of Mrs. Shirley Onderdonk. This water is pumped into a standpipe of 4,000 gallons capacity, and supplies about one tenth of the village. There are about 1,000 feet of distributing mains.

The George Hoitt system consists of two dug wells ten feet deep and a deep drilled well with a capacity of 18 gallons per minute. The water from this cistern is pumped into a standpipe of 6,500 gallons capacity and supplies about one fourth of the village. There are about 15,000 feet of distributing mains.

Examination of Water from Pettee System.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10621	1912 Nov. 19	Sl. opal	Slight	Sl. earth	0.05	.0010	.0015	.1250	.0000	1.70	6.0	....	....	+	....
10649	Dec. 3	Mod. opal	Sl. earth	Dist. earth	0.15	.0045	.0050	.0100	Ft tr.	.70	5.1	....	....	+	....
10651	Dec. 3	Sl. opal	Sl. clay	Sl. earthy	0.05	.0015	.0030	.0350	.0000	3.30	6.7	....	....	0	....
10652	Dec. 3	None	V. slight	None	0.03	.0020	.0020	.0100	.0000	1.15	5.3	....	....	0	....
10670	Dec. 9	None	Sl. floc.	None	0.00	.0015	.0020	.0050	.0000	1.15	5.3	....	....	0	....
10782	1913 Feb. 20	V. slight	V. slight	Sl. earth	0.07	.0020	.0010	.0400	.0000	.73	3.6	....	....	0	....
11706	Oct. 25	Ft. opal	Slight	None	0.05	.0010	.0024	.0050	.0000	1.10	6.0	....	....	0	....
11796	Nov. 27	None	None	None	0.00	.0010	.0020	.0050	.0000	1.15	6.4	....	....	0	0
11810	Dec. 4	None	V. slight	None	0.03	.0016	.0020	.1250	.0000	1.95	6.0	....	....	0	....

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Examination of Water from Well of George Hoitt.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10630	1912 Dec. 3	V. sl. opal	None	None	0.20	.0010	.0065	.0250	.0000	.75	4.6	....	....	+	....
11705	1913 Oct. 24	Consid. opal	V. sl. earthy	Earthy	0.55	.0010	.0186	.0100	Ft. tr.	.85	6.3	....	....	+	....
11729	Nov. 1	Sl. opal	None	None	0.20	.0020	.0100	.0050	.0000	.65	5.0	..	....	+	...

Examination of Water from Onderdonk Supply.

10594	1912 Nov. 4	None	V. slight	None	0.00	.0010	.0010	.0100	.0000	2.45	8.9	....	....	0	....
10595	Nov. 4	None	None	None	0.00	.0010	.0010	.0100	.0000	2.45	9.3	....	....	0	....
10973	1913 Apr. 4	None	V. slight	None	0.05	.0010	.0020	.0100	.0000	1.95	7.1	0.00	....	0	....
11702	Oct. 23	None	None	None	0.05	.0010	.0014	.0050	Ft. tr.	2.10	9.6	....	....	0	....

Examination of Water from Artesian Well of New Hampshire College.

10653	1912 Dec. 3	None	None	None	0.00	.0010	.0010	.0050	.0000	2.95	6.0	....	....	0	....
10671	Dec. 9	None	None	None	0.00	.0010	.0010	.0050	.0000	2.90	5.7	....	....	0	....
11701	1913 Oct. 25	None	None	None	0.03	.0026	.0034	.0100	.0000	2.30	5.4	....	....	0	....

Examination of Water from Well Supplying Gamma Theta Fraternity.

10672	1912 Dec. 9	Consid. opal	None	None	0.35	.0010	.0090	.250	Ft. tr.	.65	6.0	....	....	+	....
10692	Dec. 20	Consid. opal	None	Sl. earth	0.30	.0010	.0085	.250	.0000	.65	6.0	....	....	+	....

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Enfield.

Examination of Water from Tap of Enfield Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12192	1913 Aug. 17	None	V. slight	None	0.03	.0008	.0016	.1000	.0000	.45	5.3	.018	....	0	....

Examination of Water from Well of Baltic Mills.

11504	1913 Aug. 25	None	None	None	0.05	.0010	.0020	.0350	.0000	.35	3.4	....	....	0	....

Epping.

Examination of Water from Well of A. W. Mitchell, used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12208	1914 June 14	V. slight	Consid. earth	Earthy	0.07	.0012	.0068	.600	Tr.	2.25	5.0	....	....	+	....

Exeter.—The Exeter Water Works derives its supply from an impounded brook. Shores and bottom of impounded area very clayey. Mechanical filtration employed. Water is pumped to a standpipe of 211,000 gallons. Supplies nine hundred families, or 95 per cent of population. (See special report elsewhere.)

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Exeter Water Works.

Number	Date of Collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Alkalinity	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c.c.	10 c.c.
10,893	1913 April 11	Slight	Consid. fine wh.	Sl. earthy	0.05	.0010	.0046	.0100	.0000	.35	2.6	....	....	0	....
12,026	1914 April 20	V. slight	sl. white	Sl. earthy	0.05	.0010	.0034	.0070	.0000	.42	2.4	....	.. .	0	0
*1	1913 Jan. 11	Consid.	.....	Ft. veg.	0.85	.0040	.0252	.0050	.0000	.36	2.7	1.20	.020	0	....
*2	Jan. 11	V. slight	.....	Ft. veg.	0.25	.0110	.0136	.0860	.0001	.53	4.4	2.00	.005	0	....
*1	Feb. 20	Consid.	.....	.....	0.74	.. .	.....	.....	.....	...	....	2.40	....	....	....
*2	Feb. 20	V. slight	.....	.....	0.03	.....	.....	.....	.....	....	....	1.9	....	....	....
*1	April 9	Consid.	.....	Ft. veg.	0.90	.0022	.0260	.0800	.0000	.52	2.6	0.60	.045	0	+
*2	April 9	V. slight	.....	None	0.03	.0024	.0068	.0640	.0000	.52	3.2	0.20	.010	0	....
*1	April 24	Consid.	.....	.....	0.80	.....	.....	.....	.....	....	....	1.10	....	....	....
*2	April 24	Slight	.....	.....	0.64	.....	.....	.....	.....	....	....	1.10	....	....	....
*1	June 12	Consid.	.....	F. veg.	0.90	.0020	.0308	.0040	.0000	.42	2.7	2.10	.065	0	+
*2	June 12	Slight	.....	None	0.45	.0024	.0178	.0060	.0001	.42	3.2	1.30	.040	0	....
*3	July 1	Consid.	.....	Ft. veg.	0.90	.0026	.0292	.0000	.0000	.41	2.8	2.20	.27	....	....
*2	July 1	Slight	....	Ft. veg.	0.80	.0156	.0186	.0000	.0001	.43	3.4	1.70	.070	....	....
*2	Aug. 8	V. slight	.....	.....	0.10	.....	.....	.....	.....	....	....	1.30	.025	....	....

* Analysis by Robert Spurr Weston
[1] Raw water supply
[2] Tap
[3] Reservoir

Examination of Water from Spring of John Callahan.

11 250	1913 July 7	None	Sl. veg.	None	0.05	.0010	.0010	.0200	.0000	.45	7.1	....	....	0	....

Farmington.—The precinct supply is derived from three large dug wells located near the banks of a power canal, a certain amount of water from which is believed to reach the largest of

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these wells by seepage. On rare occasions, resort has been made to direct draft from the canal, the water syphoned therefrom being allowed to reach the wells following seepage through a natural adjacent sand bed. Daily capacity of this supply given as 1,000,000 gallons, pumped to a reservoir of 1,000,000 capacity. Furnishes water to about three hundred families.

The J. A. Fletcher supply, derived from one artesian well and one large dug well, furnishes water to about fifty families.

Examination of Water from Farmington Precinct Supply.

Number	Date of collection	Appearance			Ammonia			Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,900	1913 April 13	V. slight	Slight	None	0.15	.0010	.0050	.0025	.0000	.25	0.6	....	....	0	....
12,205	1914 April 20	V. slight	V. slight	Sl. earth	0.25	.0006	.0048	.0050	.0000	.14	0.6	....	....	0	0

Examination of Water from Supply of James A. Fletcher.

12,198	1914 June 4	V. slight	V. slight	Ft. earthy	0.15	.0020	0082	.225	.0000	1.35	2.9	....	....	0	0
12,246	June 17	Mod. opal	Mod. grey floc.	None	0.35	.0006	.0110	.0100	.0000	.60	2.0	....	....	0	+
12,318	July 6	V. slight	Sl. earth	Slight	0.45	.0024	.0194	.0030	.0000	.45	2.3	....	....	0	+

Examination of Water from Well in Edgerly Park.

12,195	1914 June 4	None	None	None	0.00	.0006	.0014	.6000	.0000	3.00	5.3	....	....	0	....
12,425	July 29	None	V. slight	None	0.00	.0006	.0018	.600	.000	2.90	5.3	....	....	0	....

Examination of Water from Well owned by Natl. Horne Estate.

12,197	1914 June 4	None	V. sl. floc.	Decid. foul	0.05	.0024	.0048	.1250	Tr'c	.90	1.9	....	....	0	....
12,289	June 25	None	V. slight	Mark foul	0.00	.0042	.0070	.0500	.0000	.80	2.0	....	....	0	....

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Examination of Water from Well on Central Street, used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12,288	1914 June 25	None	V. slight	Dist. foul	0.00	.0024	.0020	.0300	.0000	.85	4.6	....	....	0	....

Well of William H. Nute.

10,476	1912 Sept. 13	Slight	Consid. ferrug	Sl. veg.	0.05	.0008	.0046	.0500	.0000	.65	1.8	....	C'n sid.	0	....

Fitzwilliam.

Examination of Water from Well of Congregational Church.

11,101	1913 June 4	Very slight	Very slight	None	0.10	.0044	.0060	.0350	Hl'h	1.00	6.8	.010	....	0	....

Examination of Water from Spring of John Cross.

11,134	1913 June 13	V. slight	V. slight	V. slight	0.07	.0006	.0010	.0025	.0000	.08	0.4	.060	....	0	....

Francestown.—The gravity system of the Francestown Water Company furnishes water through enameled iron pipe from a spring to twenty families, one tenth of the population.

Examination of Francestown Water Company Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,926	1913 April 7	V. slight	V. sl. sand	Sl. earth	0.05	.0006	.0010	.0025	.0000	.11	1.5	....	....	0	....
12,047	1914 April 27	None	None	None	0.00	.0006	.0020	.0050	.0000	.10	1.1	....	....	0	0

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Franconia.—The Franconia Water Company supplies water to fifty families by a gravity system having its source in a spring on Mt. Thayer.

Examination of Water from Franconia Water Company Supply.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,906	1913 April 15	V. slight	V. sl. fine	Sl. earth	0.00	0006	.0010	.0025	.0000	.06	1.1	.020	...	0	....
12,006	1914 April 10	None	V. slight	Dist. arom.	0.03	.0006	.0014	.0050	.0000	.05	0.9	.030	...	0	0

Franklin.—The supply of the city of Franklin is derived mainly from a series of springs, the divisions of the system being known as the Coldbrook, Elkins and White. Water is also obtained from tubular wells on the bank of the Pemigewasset River, and from the river itself, following filtration, during times of drought. (See special report elsewhere.)

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Examination of Water from Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,606	1912 Nov. 8	Moderate	Mod. ferrug	None	0.03	.0010	.0020	.0050	.0000	.12	1.2	...	....	0	....
10,918	1913 April 17	None	None	None	0.05	.0014	.0020	.0100	.0000	.10	1.2	....	....	0	....
11,202	July 1	None	None	None	0.05	.0010	.0010	.0100	.0000	.13	1.0	....	....	+	....
11,230	July 14	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	0	0
11,373	Sept. 10	None	V. slight	None	0.20	.0010	.0020	.0100	.0000	.18	1.4	....	....	0	....
11,865	1914 Jan. 15	V. slight	Slight	None	0.05	.0008	.0012	.0050	.0000	.13	1.2	....	....	0	....
11,905	Feb. 2	V. slight	Slight	Marshy	0.25	.0018	.0082	.0100	.0000	.08	1.1	....	....	0	+*
11,914	Feb. 23	V. slight	None	Sl. musty	0.20	.0008	.0050	.0050	.0000	.12	0.9	.02	....	0	0
11,926	Mar. 3	Sl. opal	Mod. earth	Ft. earthy	0.12	.0010	.0048	.0050	.0000	.13	1.4	....	...	0	0
11,943	Mar. 13	None	V. sl. fine	None	0 02	.0006	.0008	.0050	.0000	.24	1.2	....	....	0	0a
11,944	Mar. 13	None	None	None	0.02	.0006	.0020	.0050	.0000	.14	0.7	....	....	0	0b
11,945	Mar. 13	None	V.slight	None	0.02	.0008	.0018	.0050	.0000	.24	1.4	....	....	0	0c

* Pemigewasset River
a Elkins Spring
b Cold Brook Spring
c White Well

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Examination of Water from Mill Pond used at Main-Street Station, Boston & Maine Railroad.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,504	1912 Sept. 25	None	Sl. floc.	None	0.15	.0010	.0015	.0050	.0000	.05	1.9	0.20	....	+	....
						Well of Hector Morin.									
12,085	1914 April 2	None	None	None	0.00	.0010	.0054	.5000	.0000	.95	5.3	.020	....	0	....
						Well of Elizabeth Clement.									
11,324	1913 July 30	None	None	None	0.05	.0010	.0020	.100	H'h	1.05	1.9	.010	....	+	....
						Spring Supplying Hospital.									
10,598	1912 Nov. 4	V. slight	Sl. floc.	None	0.05	.0005	.0005	.0050	.0000	.25	2.6	....	sm.	0	....

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**Bacteriological Examinations of Water from Franklin Supply.*

Date of Collection	Source	Bacteria per c.c.		Colon Bacilli	
		Agar (37°c)	Agar Gelatin (20°c)	1 c.c.	10 c.c.
1914 Feb. 12	Tap pumping station (filtered)	1	30	....	....
Feb. 12	Tap pumping station (filtered)	1	20	....	....
Feb. 12	River (raw water)	7	100	....	....
Feb. 12	River (raw water)	6	100	....	....
Feb. 18	River water (raw water)	8	410	+	....
Feb. 18	River water (raw water)	11	430	+	+
Feb. 18	Tap Bow Street station	5	38	0	....
Feb. 18	Tap Judkins & Wallace's store	6	43	0	....
Feb. 23	[1] Tap Judkins & Wallace' sstore(filtered)	256	418	0	0
Feb. 23	Tap Bow Street station (filtered)	1	87	0	0
Feb. 23	River (raw water)	38	30	+	+
March 5	River (raw water)	18	1,100	+	+
March 5	River (raw water)	30	600	0	+
March 5	[1] Tap Judkins & Wallace's store	107	10	0	0
March 5	Bow Street station	2	100	0	0

* While the Pemegewasset River at Franklin is apparently not a badly polluted stream under normal conditions, yet at the time these samples were collected very cold weather prevailed, a fact doubtless having some bearing upon the rather unexpectedly 37 degree counts obtained.

[1] As possibly bearing upon the relatively high 37° counts here obtained, it may be stated that these samples represent water from pipes exposed in rather unusual degree to the warmth of the building.

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Freedom.

Examination of Water from Spring of J. E. Perkins, Supplying Prospect House.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,425	1913 Aug. 13	None	Mod. earth	None	0.05	.0006	.0010	.0050	.0000	.01	1.9	.040	....	0	....

Examination of Water from Spring of Mrs. J. P. Gordon, Supplying Hotel Elms.

11,426	1913 Aug. 13	Sl. opal	V. sl.	None	0.05	.0006	.0014	.0050	.0000	.05	0.4	.050	....	0	....

Fremont.

Well Water Supplying Schools.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,828	1913 Dec. 14	Sl. opal	Consid. veg.	Strong veg.	0.07	.0006	.0048	.0050	.0000	.70	3.2	....	....	0	....

Goffstown.—The precinct gravity system is derived from two spring-fed reservoirs located between the Uncanoonuc Mountains. During periods of drouth water is sometimes pumped from a small pond about one half a mile below the reservoirs and on the same brook.

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Examination of Water from Goffstown Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,904	1913 April 13	Slight	Sl. fibre	V. slight	0.10	.0026	.0050	.0025	.0000	.13	0.3	...	...	0	....
11 521	Aug. 28	Sl. fine	V. slight	Sl. arom.	0.45	.0014	.0040	.0050	.0000	.13	0.7	....	....	0	....
12,024	1914 April 19	V. slight	Mod. fine	Earthy	0.03	.0028	.0050	.0060	.0000	.16	0.3	....	....	0	0

Water from Barnard Pond (Pumped to Precinct Supply Reservoir at this date.)

11,594	1913 Sept. 16	Consid.	Consid. floc.	Faint veg.	.50	0010	.0340	.003	.0000	.20	.7	..	.050	0	0

Driven Well of Kendall, Hadley & Company.

11,515	1913 Aug. 28	None	None	None	0.05	.0010	.0010	.2000	.0000	1.50	3.9	..	....	0	....

Gorham.—The town system, derived from a stream, supplies about three hundred families. An earlier system, the Alpine Aqueduct Company, furnishes one hundred and sixty services from a series of seventeen springs.

Examination of Water from Town System.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,924	1913 April 21	None	None	None	0.15	.0006	.0040	.0025	.0000	.04	0.1	....	....	0	....
12,021	1914 April 16	None	None	None	0.12	.0008	.0034	.0050	.0000	.04	0.1	....	....	0	0

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Greenville.—The artesian well supply is of inferior quality and limited as to quantity. During the past two years the town has been investigating the matter of a regular public system and is now planning to install a supply from Pratt Pond. (See special reports elsewhere.

Examination of Water from Town Well.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10901	1914 April 14	Slight	Mod. fine floc.	Dist. earthy	0.35	.0010	.0075	.0100	High	.25	3.9	....	Much	0	....

Examination of Water from Proposed Sources of Public Supply.

10967	1913 April 28	None	Sl. fine	Ft. earth	0.03	.0006	.0010	.0200	.0000	.35	1.2	....	....	0	[1]
10968	April 28	None	Sl. floc.	None	0.03	.0006	.0016	.0050	.0000	.07	0.7	....	.005	0	[2]
11060	May 26	Heavy	Consid. earth	Mark. veg.	0.35	.0020	.0034	.0050	Tr.	.08	1.1	....	.025	0	[3]
11061	May 28	Mod. opal	Mod. ferrug.	Sl. earth	0.60	.0026	.0020	.0100	.0000	.08	1.2	....	.100	0	[4]
11122	June 15	Consid. opal	Mod. fine	Ft. earth	0.10	.0020	.0020	.0050	.0000	.08	0.7	....	.075	0	[3]
11123	June 15	Consid. opal	Mod. fine	None	0.35	.0014	.0010	.0050	.0000	.09	0.9	....	.150	0	[4]
11180	June 22	Slight	Mod. floc.	None	0.05	.0006	.0010	.0050	.0000	.08	0.6	....	.007	0	[5]
11597	Sept. 5	V. slight	Sl. fine earth	Arom.	0.15	.0020	.0024	.0150	Ft. tr.	.15	1.5	....	.030	0	[6]
11598	Sept. 15	Consid. opal	Heavy clay	Sl. earth	0.20	.0008	.0056	.0200	Ft. tr.	.56	1.6	....	.035	—	[7]
11788	Nov. 25	Sl. opal	Mod. earth	Ft. earth	0.03	.0008	.0018	.0050	.0000	.10	1.2	....	....	0	[8]
11875	1914 Feb. 2	Sl. opal	Slight	None	0.05	.0006	.0014	.0050	.0000	.10	1.1	....	....	0	+[8]
12129	May 18	Slight	Sl. floc.	Sl. swamp	0.35	.0010	.0090	.0040	.0000	.16	0.1	...	....	0	+[8]
12130	May 18	Sl. fine	Sl. floc.	V. slight	0.10	.0012	.0100	.0030	.0000	.09	0.1	....	....	0	+[9]

[1] Spring by Railroad Station.
[2] Sawtelle spring.
[3] Test well, 31 ft. deep.
[4] Test well, 23 ft. deep.
[5] Boiling spring.
[6] Test well.
[7] Test well.
[8] Ashley's pond, New Ipswich.
[9] Pratt pond, Smithville.

Examination of Water from Spring of James Rafuse.

10859	1913 May 30	None	None	None	0.05	.0010	.0040	.3000	Tr.	2.20	4.6	....	....	—	....

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Hampton.—The original source of the Hampton Water Works Company, supplying Hampton Beach Village Precinct, was a series of driven wells. During the summer season of 1913 this supply became inadequate, and the construction of two large dug wells not relieving the situation, it was found necessary to supplement the main source by water from a brook. The latter was continued for two or three weeks, following the approval of the State Board of Health on condition that hypochlorite be used. While the well water supply is normally good, the shortage during 1913 provoked an abnormal draft upon this source, resulting in considerable impairment of quality and leading to numerous complaints.

During 1914 the new Marston spring system was completed, such affording an adequate supply of excellent character for the villages of Hampton Beach, Little Boar's Head, Rye Beach and North Hampton. (See special reports elsewhere.)

Examination of Water from Supply of Hampton Water Works Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1913														
10909	April 14	V. slight	None	None	0.00	.0014	.0020	.0200	.0000	1.65	2.6	....	....	0	....
11394	Aug. 8	Consid. white	V. fine	V. slight	0.15	.0010	.0036	.0100	.0000	1.40	3.7	....	....	+	....
11395	Aug. 8	Sl. fine	V. slight	None	0.10	.0010	.0030	.0100	.0000	1.38	3.2	....	....	+	....
11429	Aug. 13	None	None	None	0.05	.0010	.0034	.0100	.0000	1.25	3.3	....	....	0	....
11431	Aug. 12	None	Sl. earth	Sl. marsh	0.05	.0010	.0030	.0100	.0000	1.20	4.0	....	....	+	....
11432	Aug. 12	V. slight	Sl. earth	Earth	0.07	.0010	.0035	.0100	.0000	1.30	3.9	....	....	+	....
11433	Aug. 13	None	None	None	0.05	.0010	.0030	.0100	.0000	1.15	3.3	....	....	0	....
11434	Aug. 13	Consid.	Consid. ferrug.	Mark. earth	0.35	.0010	.0040	.0100	.0000	1.35	3.9	....	....	0	....
	1914														
11971	Mar. 24	None	None	None	0.05	.0010	.0016	.0300	.0000	1.30	3.2	....	....	0	0
12074	May 15	None	No e	None	0.02	.0006	.0010	.0300	.0000	1.20	2.9	....	....	0	0
12399	July 21	None	None	None	0.05	.0006	.0010	.0400	.0000	1.30	3.5	....	....	0	0
12400	July 21	Mod.	Mod. fine floc.	Sl. earth	0.23	.0016	.0086	.0300	.0000	1.30	3.1	....	....	0	0
12495	Aug. 17	None	Sl.earthy	None	0.00	.0003	.0006	.0800	.0000	1.50	3.3	....	....	0	0
12496	Aug. 17	None	V. slight	None	0.00	.0002	.0004	.0800	.0000	1.50	3.2	....	....	0	0

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**Bacteriological Examination of Water of Hampton Water Works.*

Date of collection	Source	Bacteria per c. c.		Colon Bacilli	
		Agar 37°	Agar Gelatin 20°	1 c. c.	10 c. c.
1913					
Aug. 11	Brook intake	Many	.....	+	+
Aug. 11	Roadway on brook	Many	.....	+	+
Aug. 11	Station tap	6000	.....	+	+
Aug. 11	Well (storage for brook water)	6000	.....	+	+
Aug. 14	Tap in station (driven well only)	147	.....	0	0
Aug. 14	Short brook	278	.....	0	+
Aug. 14	Tap in station (Long brook water)	11528	.....	+	+
Aug. 21	Intake at brook	7900	.....	+	....
Aug. 21	Tap at pumping station	48	.....	0	....
Aug. 21	Well containing brook water	9000	.....	0	....
Aug. 21	Tap at pumping station	51	.....	0	[1]
Aug. 27	Intake at brook	6500	34000	+	....
Aug. 27	Tap at station (brook water)	33	600	0	[1]
Aug. 27	Well (contains brook water)	7000	40000	0	....
Aug. 27	Tap at station	40	750	....	[1]

*The period of use of hypochlorite was short, and at that time the Board not having adopted the policy of keeping constantly on hand an emergency equipment, the one here employed was very crude. The colon results and relatively high counts at 37° are undoubtedly referable to farm drainage entering the brook, the inspection showing no evidence of house sewage.

[1] Treated water.

Hancock.—The town supply is derived from an impounded brook, the storage of 2,000,000 gallons thus afforded supplying 75 per cent of the population by gravity.

Examination of Water from Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10922	1913 Apr. 18	None	None	None	0.15	.0010	.0054	.0050	.0000	.12	0.8	....	....	0	....
12031	1914 Apr. 20	V. sl. opal	None	Sl. earth	0.15	.0006	.0054	.0030	.0000	.06	0.4	....	....	0	0

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Hanover.—The Hanover Water Works consists of a gravity system from an impounded brook.

Examination of Water from Supply of Hanover Water Works.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,927	1913 April 21	V. slight	Sl. earth	Sl. earth	0.35	.0030	.0130	.0050	.0000	.08	1.2	1.2	0.00	0	....
10,928	April 21	Slight	Mod. floc.	Sl. arom.	0.40	.0070	.0170	.0050	.0000	.08	0.6	0.6	....	0	....
12,155	1914 May 25	Slight	Sl. veg.	Arom.	0.25	.0014	.0158	.0030	.0000	.07	0.9	0.9	...	0	0

Haverhill.—A limited supply is furnished to certain residents of Haverhill precinct from a spring, the water being conveyed through lead pipe. Plans for the installation of a precinct system have been adopted,—for a description of which see elsewhere.

The supply of Woodsville precinct, from the Ammonoosuc River, has recently been shorn of its one-time highly dangerous character through the installation (September, 1914) of a system of chlorination. Reference to the latter appears elsewhere in this report.

Examination of Water from Supply of Haverhill Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10930	1913 Apr. 28	V. slight	V. slight	Sl. earth	0.05	.0006	.0010	.0025	0000	.09	1.5	.075	....	0	....
12048	1914 Apr. 24	Sl. opal	None	Sl. Earth	0.05	.0010	.0064	.0030	.0000	.05	1.2	.050	....	0	0

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Examination of Water from Supply of Woodsville Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,030	1913 May 21	V. slight	Sl. floc.	Sl. earth	0.35	.0010	.0066	.0050	.0000	.05	2.0	....	....	0	....
11,141	June 17	Very slight	Slight	Sl. earthy	0.35	.0006	.0050	.020	.0000	.03	0.1	....	....	0	....
11,338	Aug. 4	V. faint	Mod. cs. floc.	Sl. swamp	0.35	.0020	.0110	.0100	.0000	.11	1.5	....	...	+	....
12,269	1914 June 24	V. sl. opal	Sl. br. floc.	None	0.15	.0006	.0072	.0030	.0000	.11	1.2	....	....	+	+
12,271	June 24	None	Mod. floc.	None	0.00	.0010	.0018	.0030	.0000	.24	2.2	.050	....	+	+[1]
12,426	July 29	None	Con. earth	None	0.00	.0006	.0014	.0050	.0000	.28	2.6	.030	....	0	0[1]

[1] From public standpipe, spring water source.

Examination of Water from Springs. Proposed Source of Public Supply for Haverhill Precinct.

11444	1913 Aug. 15	V. S l ht	Slight	Earthy	0.05	.0020	.0060	.0750	.0000	.30	6 9	....	....	+	...[1]
11451	Aug. 19	Sl. earthy	Sl. earthy	Sl. earthy	0.03	.0054	.0058	.1250	.0000	.25	7.1	....	....	0	...[2]
11463	Aug. 21	None	None	None	0.00	.0012	.0016	.0040	.0000	.14	6.0	....	....	0	...[3]
11464	Aug. 21	None	Sl. floc.	None	0.00	.0004	.0012	.0020	.0000	.11	5.3	....	....	0	...[3]

[1] Roadside spring. [2] From ravine, above source of No. 11,444
[3] Morris farm spring

Examination of Water from Supply of Lake Tarleton Club.

12323	1914 July 6	V. slight	V. slight	Sl. earth	0.03	.0006	.0028	.4000	Ft. trac	1.80	4.9	....	....	0	+[1]
12324	July 6	V. slight	V. slight	Sl. marsh	0.12	.0024	.0094	.0050	.0000	.03	0 6	....	....	0	+[2]

[1] From well. [2] From lake

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Examination of Water from Reservoir Supplying Grafton County Farm.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10772	1913 Feb. 20	Slight	Sl. earth	.....	0.35	.0040	.0065	.0025	.0000	.10	2.4	....	....	0	....

Examination of Ice Supplied to Boston & Maine Railroad (N. J. Miller).

12011	1914 Apr. 13	V. sl. opal	V. sl. floc.	V. sl. musty	0.00	.0006	.0008	.0025	.0000	.04	0.0	....	....	0	0

Examination of Ice as Sold in Woodsville.

10831	1913 Mar. 18	Slight	Mod. floc.	V. faint	0.05	.0010	.0030	.0025	.0000	.05	0.0	....	....	0	....

Henniker.—During 1914, the Henniker Spring Water Company's system was acquired by the town and greatly extended. (See special report elsewhere.)

Examination of Water from Henniker Spring Water Company's System.

10932	1913 April 21	Slight	Sl. floc.	None	0.00	.0006	.0010	.0025	.0000	.10	0.9	....	....	0	....
11749	Nov. 10	Ft. opal	None	Ft. swamp	0.10	.0008	.0050	.0025	.0000	.08	1.4	....	....	0	+
11915	1914 Feb. 22	None	V. slight	None	0.03	.0014	.0018	.0050	.0000	.08	3.2	....	.005	0	0
12057	April 30	V. sl. opal	None	None	0.02	.0008	.0020	.0100	.0000	.07	0.7	....	....	0	0

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Examination of Water from Sources under Consideration for Public Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11730	1913 Nov. 5	V. slight	Sl. veg.	Fishy	0.40	.0006	.0214	.0020	.0000	.11	0.6	....	....	....	...[1]
11731	Nov. 5	V. slight	Sl. veg.	Fishy	0.35	.0008	.0180	.0020	0000	.11	0.6	....	....	....	...[2]
11732	Nov. 5	V. slight	Sl. veg.	Fishy	0.40	.0006	.0255	.0020	.0000	.12	0.5	....	....	0	...[3]
12229	1914 June 11	Mod. opal	Mod. earth	Dist. earth.	0.07	.0006	.0014	.0030	.0000	.14	1.1	....	.125	0	...[4]
12230	June 11	None	Sl. br'n floc.	Sl. swamp	0.30	.0006	.0044	.0030	.0000	.07	0.1	....	.002	+	...[5]

[1] Brook flowing from Crany Hill pond. [2] Crany Hill pond, west shore.
[3] Crany Hill pond, east shore. [4] Test well in Garland land.
[5] Stream from springs near test well.

Hill.—The Hill Water Works, a gravity system, has its source in a spring and stream, water from the latter being permitted to seep through sandy soil into a collecting well. In 1912 the number of services was fifty-seven, hydrants, six; mains, cement-lined.

Examination of Water from Supply of Hill Water Works.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10991	1913 May 8	Moderate	Mod. gelot.	None	0.35	.0010	.0090	.0050	.0000	.13	0.1	....	....	0	....
12156	1914 May 25	Slight	Slight	V. slight	0.28	.0006	.0074	.0030	.0000	.15	1.2	....	....	0	0

Hillsborough.—Hillsborough Bridge precinct has a public system from a pond of five hundred acres; distribution by gravity from a reservoir of 500,000 gallons. Mains partially cement-lined.

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Examination of Water from Supply of Hillsborough Bridge Precinct System.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1913														
10914	April 17	Slight	V. slight	Slight	0.25	.0010	.0080	.0025	.0000	.08	0.1	....	....	0	....
11640	Oct. 20	None	None	Sl. marsh	0.10	.0010	.0164	.0050	.0000	.09	0.1	....	....	0	....
	1914														
12040	April 24	Ft.	None	None	0.20	.0006	.0086	.0030	.0000	.08	0 1	....	....	0	0

Hooksett.

Examination of Water from Well Supplying Union School District.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1913														
11632	Sept. 26	None	V. slight	Sl. foul	0.05	.0010	.0010	.0500	.0000	.68	2.4	....	....	+	....
11635	Sept. 29	None	V. slight	Sl. earth	0.05	.0010	.0014	.0500	.0000	.70	2.4	....	....	+	....

Hopkinton.—Contoocook precinct is supplied by a gravity system from Bear Pond.

Examination of Water from Contoocook Village Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1913														
10916	Apr. 17	V. slight	None	None	0.10	.0010	.0070	.0050	.0000	.14	0.1	....	....	0	....
	1914														
12049	Apr. 27	V. slight	V. slight	Sl. earth	0.05	.0010	.0064	.0030	.0000	.12	0.3	....	....	0	0

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Examination of Water from Well of Davis Paper Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10637	1912 Nov. 25	None	V. slight	Ft. earth	0.00	High	.0020	.0100	High	.25	3.9	....	....	0	....
11131	1913 June 11	Slight	Sl. white	Sl. foul	0.05	.0010	.0020	.0500	High	.15	2.6	....	....	0	....

Examination of Water from Well Supplying Roberts Cottage.

11305	1913 July 25	Mod. opal	Sl. brown floc.	Sl. foul	0.20	.0040	.0050	.1500	Tr.	.70	2.0	....	....	0	....

Examination of Water from Well of Amos F. Frye Supplying Great Elm Farm.

11307	1913 July 25	None	Sl. brown floc.	None	0.05	.0006	.0010	.0050	.0000	.60	3.9	....	...	0	....

Hudson.—The Hudson Water Works system consists of two large dug wells, supplemented during 1913 by a series of driven wells. The well water is of good quality as a whole. The objectionable Ottarnic Pond auxiliary source has been discontiuned. (See special report elsewhere.)

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Examination of Water from Supply of Hudson Water Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1912														
10450	Sept. 3	V. slight	V. slight	None	0.03	.0010	.0015	.0200	.0000	.27	1.4	....	....	0	....
10527	Oct. 2	V. slight	Sl. floc.	Ft. earthy	0.05	.0005	.0010	.0100	.0000	.38	1.2	....	....	0	....
10528	Oct. 2	V. slight	Sl. earthy	Ft. earthy	0.00	.0020	.0010	.0200	.0000	.80	3.6	....	....	0	....
	1913														
10713	Jan. 16	None	V. slight	None	0.05	.0006	.0022	.0050	.0000	.30	1.9	....	....	0	....
10714	Jan. 16	V. faint	None	Mark veg.	0.00	.0006	.0024	.0050	.0000	.35	3.2	....	...	0	....
10835	Mar. 27	V. slight	V. slight	None	0.07	.0014	.0010	.0050	.0000	.28	0.9	....	....	0	....
10836	Mar. 27	V. slight	V. slight	None	0.05	.0010	.0010	.0050	.0000	.34	1.4	....	....	0	....
10837	Mar. 27	V. slight	V. slight	None	0.07	.0006	.0010	.0025	.0000	.32	1.4	....	....	0	....
10872	Apr. 8	V. slight	V. sl floc.	Sl. earth	0.05	.0010	.0036	.0050	.0000	.27	1.5	....	.015	0	....
10873	Apr. 8	V. slight	Sl. gray floc.	Sl. earth	0.05	.0010	.0040	.0050	.0000	.35	1.4	....	.025	0	....
10874	Apr. 8	Slight	V. sl. floc.	Dist. earth	0.05	.0010	.0030	.0050	.0000	.36	1.8	....	.000	0	....
	1914														
10920	Feb. 25	None	None	Sl. earth	0.05	.0010	.0014	.0100	.0000	.30	1.6	....	.001	0	0
12050	Apr. 27	None	None	None	0.02	.0008	.0020	.0100	.0000	.23	1.4	....	.005	0	0

Examination of Water from Well Supplying Hudson School District.

	1913														
11844	Dec. 30	Sl. opal	Mod. floc.	Sl. musty	0.10	.0010	.0064	.0300	Tr.	.90	7.4	....	....	+	....

Jackson.

Examination of Water from Spring Supplying Wentworth Hall.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1912														
10502	Sept. 23	None	None	None	0.00	.0005	.0005	.0025	.0000	.05	1.8	....	....	0	....

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Examination of Water from Spring Supplying School District.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11048	1912 May 22	Heavy	Heavy earthy	Earthy	0.70	.0020	.0130	.0200	High	.10	1.9	....	....	0	
11568	Sept. 8	Heavy opal	Heavy earthy	None	0.10	.0044	.0065	.0080	.0000	.04	1.4	....	....	+	[1]

[1] New well just completed.

Jaffrey.—The town system consists of a gravity supply from Bullet Pond, located in Rindge.

Examination of Water from Bullet Pond Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10746	1913 Feb. 10	None	None	Mark. veg.	....	.0010	.0110	.0050	.0000	.15	0.3	....	....	0	....
12030	1914 Apr. 23	Sl. opal	V. sl. floc.	Sl. veg.	....	.0038	.0118	0050	.0000	.12	0.1	....	....	0	....

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Jefferson.

Examination of Water Supplying Boston & Maine Railroad, Trains and Stations.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11150	1913 June 18	V. slight	Sl. floc.	Sl. arom.	0.35	.0006	.0050	.0050	.0000	.05	0.1	....	....	+	[1]
11201	July 1	None	None	Earthy	0.10	.0006	.0010	.0350	.0000	.10	1.6	....	....	0	[2]
11217	July 8	None	Sl. fine	Marked musty	0.15	.0006	.0038	.0050	.0000	.05	0.4	....	....	+	[1]
12264	1914 June 19	None	Sl. brown floc.	Sl. musty	0.15	.0010	.0030	.0060	.0000	.05	0.7	....	....	0	0[3]
12298	June 29	None	V. sl. floc.	None	0.10	.0008	.0020	.0030	.0000	.05	0.7	.010	....	0	0[3]

[1] Stream—Meadows station.
[2] Spring—Jefferson station.
[3] Stream—Cherry mountain station.

Examination of Ice Supplying Boston & Maine Railroad (Cherry Mountain).

12281	1914 June 25	V. slight	None	Sl. earth	0.00	.0010	.0014	.0030	.0000	.04	0.0	....	....	0	....

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Keene.—The city supply is derived from two ponds.

Examination of Water from Keene Supply.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10926	1913 Jan. 24	V. slight	Sl. veg.	Sl. musty	0.15	.0006	.0030	.0050	.0000	.15	0.3	.020	....	0	....
11025	May 17	V. slight	V. slight	Dist. earth	0.15	.0034	.0110	.0050	.0000	.12	0.2	....	....	0	....
11059	May 25	None	V. slight	V. slight	0.20	.0010	.0150	.0050	.0000	.08	1.9	....	....	0	....
11062	June 1	V. slight	Mod. floc.	Sl. earth	0.35	.0040	.0100	.0025	.0000	.09	0.1	....	....	0	....
12051	1914 April 27	Slight	Mod. floc.	None	0.25	.0006	.0094	.0030	.0000	.08	0.3	....	.050	0	+
12020	May 4	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	+	+
12121	May 4	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	0	+
12122	May 4	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	0	+
12123	May 4	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	+	+
12150	May 22	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	0	0
12151	May 22	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	0	0
12152	May 22	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	0	0

Examination of Water from Spring of Keene Development Co.

12215	1914 June 8	V. Slight	Consid. gray floc.	Oily	0.03	.0020	.0022	.0030	.0000	.30	3.6	....	....	0	....

Laconia.—The source of the Laconia Water Company's supply is Lake Paugus, the water being pumped to a reservoir of 2,700,000 gallons, following treatment by calcium hypochlorite, the latter having been adopted during 1912. Mains in part of cement-lined pipe, with cement-lined services. (See special discussion of chlorination with reference to Lakeport plant elsewhere.)

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Examination of Water from Supply of Laconia Water Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10656	1912 Dec. 4	Slight	Sl. earth	Earth arom.	0.05	.0010	.0050	.0050	.0000	.12	0.6	....	....	0	....
10657	Dec. 4	V. slight	None	V. sl. earth	0.00	.0010	.0040	.0050	.0000	.13	0.6	....	....	0	....
10755	1913 Feb. 13	V. sl. opal	V. slight	None	0.07	.0010	.0060	.0050	.0000	.12	0 6	....	....	0	....
10756	Feb. 13	None	None	None	0.00	.0010	.0050	.0025	.0000	.13	0.4	....	....	0	....
10913	April 17	V. slight	None	None	0.07	.0010	.0060	.0050	.0000	.17	0.4	...	....	0	....
11892	1914 Feb. 4	None	None	None	0.10	.0008	.0090	.0050	.0000	.13	1.2	....	....	0	0
11893	Feb. 4	None	V. slight	None	1.10	.0006	.0088	.0050	.0000	.12	0.9	....	....	0	0
12028	April 22	V. sl. opal	None	None	0.02	.0008	.0080	.0040	.0000	.13	0.4	....	....	0	0

Examination of Water from Saltmarsh Pond.

10475	1912 Sept. 13	V. slight	V. slight	Ft. marsh	0.05	.0024	.0114	.0020	.0000	.12	1.4	....	....	0	....

Examination of Water from Spring of Fred Hoyt, known as Laconia Spring.

12214	1914 June 12	None	None	None	0.00	.0006	.0006	.0030	.0000	.07	1.2	....	....	0	0

Bacteriological Examination of Laconia Supply.

The water of Lake Paugus is normally very clean chemically, the organic content being quite low. However, on account of the Weirs sewage discharge at the channel entering this lake, chlorination was found necessary. Notwithstanding the highly satisfactory character of this water from a chemical standpoint, the bacteriological examinations recorded below indicate that at times at least, the bacterial population is very large. It is interesting

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to note the effectiveness of a small dose of hypochlorite under these conditions, it being apparent (a) that in the absence of organic matter, the bacterial destruction by even minute amounts of this chemical is very extensive; (b) that the forms first killed off are the varieties growing at body temperature, i. e., those typical of sewage and therefore the ones whose death is most essential.

During the past two years the amount of hypochlorite employed at Lakeport has been equivalent to but about one tenth part chlorine per million—an effective amount the smallness of which thus far seems to be without precedent. While it is true that the residual numbers of ordinary water bacteria is in a number of cases larger than the usual practice recognizes, yet in every instance the destruction of those of the colon type is satisfactorily complete. Nevertheless, it will possibly we well, in the future, to increase the dosage slightly.

During the past two years the scientific supervision of this plant has been under the direct control of the chemist of the board.

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Bacteriological Examination of Laconia Supply.

Number	Date of Collection	Source	Bacteria per c.c.		Colon Bacilli	
			Agar (37°c)	Agar-Gelatin (20°c)	1 c.c.	10 c.c
.....	1913 July 11	Tap, Union Ave.....	56	67	0	....
.....	July 11	Tap, Pumping Station.....	59	66	0	....
.....	July 11	Lake Paugus (raw water).....	.....	2,244	+	....
.....	July 22	Lake Paugus (raw water).....	660	12,177	0	....
.....	July 22	Tap, Pumping Station.....	43	897	0	....
.....	July 22	Tap, Clinton Street.....	11	26	0	....
.....	July 22	Tap, Union Ave.....	36	274	0	....
11361	July 29	Lake Paugus (raw water).....	4,500	58,500	0	0
11362	July 29	Tap, 960 Union Ave.....	32	650	0	0
11363	July 29	Tap, 435 Union Ave.....	91	750	0	0
11364	July 29	Tap, 766 Union Ave.....	.....	.....	0	0
11396	Aug. 7	Lake Paugus (raw water).....	4,000	6,800	+	+
11397	Aug. 7	Tap, Main Street.....	75	200	0	+
11398	Aug. 7	Tap, Union Ave.....	30	450	0	0
11399	Aug. 7	Tap, High Street.....	100	200	0	0
11478	Aug. 20	Lake Paugus (raw water).....	5,400	59,000	+	....
11479	Aug. 20	Tap, Union Ave.....	40	700	0	....
11480	Aug. 20	Tap, Fair Street.....	130	825	0	....
11481	Aug. 20	Tap, Pumping Station.....	25	800	0	....
11525	Aug. 27	Lake Paugus (raw water).....	53,500	56,000	0	....
11526	Aug. 27	Tap, Pumping Station.....	28	450	0	....
1527	Aug. 27	Tap, Union Ave.....	37	600	0	....
1	Aug. 27	Tap, Bayside Court.....	140	700	0	....

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Number	Date of collection	Source	Bacteria per c.c.		Colon Bacilli	
			Agar (37°c)	Agar-Gelatin (20°c)	1 c.c.	10 c.c.
.....	1913 Sept. 3	Lake Paugus (raw water)	15,000	28,000	+	....
.....	Sept. 3	Tap, Elm Street	9	245	0	....
.....	Sept. 3	Tap, Union Ave	18	450	0	....
.....	Sept. 3	Tap, Water Street	27	600	0	....
.....	Sept. 9	Lake Paugus (raw water)	800	3,200	+	...
.....	Sept. 9	Tap, Pumping Station	4	24	0	....
.....	Sept. 9	Tap, Fall Street	29	115	0	...
.....	Sept. 9	Tap, 980 Union Avenue	29	90	0	...
.....	Sept. 17	Lake Paugus (raw water)	820	3,000	0	....
.....	Sept. 17	Tap, Gilford Ave	34	164	0	...
.....	Sept. 17	Tap, Union Ave	45	80	0	....
.....	Sept. 17	Tap, Elm Street	8	190	0	....
.....	Sept. 25	Lake Paugus (raw water)	850	30,000	0	...
.....	Sept. 25	Tap, Union Ave	11	92	0	....
.....	1914 March 9	Tap, Union Ave	4	100	0	0
.....	March 9	Lake Paugus (raw water)	400	900	....	+
.....	March 9	Tap, Water Street	6	55	0	0

Lancaster.—The precinct supply is derived from a mountain stream piped to a distributing reservoir of 2,000,000 gallons. (See special report elsewhere.)

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Examination of Water Supply of Lancaster.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10929	1913 Apr. 19	None	None	V. sl. earth	0.07	.0006	.0030	.0050	.0000	.07	0.1	....	....	0	....
11912	1914 Feb. 20	.....	.....	.....	....	.....	.....	.....	.....	....	....	....	....	+	+*[1]
11917	1914 Feb. 24	V. slight	Sl. floc.	Sl. earth	0.23	.002	.0046	.0100	0000	.07	0.9	....	....	+	+*
12029	Apr. 22	V. slight	V. slight	V. slight	0.15	.0006	.0054	.0030	.0000	.05	0.1	....	....	0	....

*Mill Pond on Israel River. [1]Also shows colon bacilli in 0. 1. c. c.

Examination of Ice Supplied Boston & Maine Railroad.

10825	1913 Mar. 24	V. slight	Sl. cotton fibre	None	0.00	.0010	.0010	.0025	.0000	.03	0.0	....	...	0	....
12241	1914 June 17	V. sl. opal	Sl. floc.	None	0.00	.0006	.0020	.0030	.0000	.06	0.0	....	....	0	....

Lebanon.— The precinct system consists of water from the Mascoma River, purified by mechanical filtration with alum.

Examination of Water from the Lebanon Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10890	1913 Apr. 9	Sl. opal	V. sl. fine	Earthy	0.25	.0014	.0100	.0025	.0000	.15	1.2	0	....	0	....
10915	Apr. 17	Slight	None	None	0.15	.0010	.0070	.0050	.0000	.12	1.5	....	....	0	.. .
11719	Oct. 27	None	None	None	0.03	.0018	.0072	.0030	.0000	.12	1.9	....	....	0	....
11720	Oct. 27	None	None	None	0.02	.0010	.0076	.0050	.0000	.12	1.9	....	....	0	....
12032	1914 Apr. 23	Mod. opal	Sl. ferrug.	V. slight	0.15	.0006	.0064	.0030	0000	.10	1.6	....	Tr.	0	....

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West Lebanon is supplied with water of good quality by the Hartford Water Company, White River Junction, Vt. During 1913 the Vermont source became inadequate and it was necessary to resort to pumping on the New Hampshire side from the Connecticut River, and from a spring.

Examination of Water Supplied West Lebanon by Hartford Water Company, White River Junction, Vt.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11445	1913 Aug. 18	V. slight	Sl. coarse floc.	Sl. earth	0.45	.0026	.0110	.0025	.0000	.05	4.0	....	....	+	[1]
11447	Aug. 18	None	Sl. coarse veg.	Foul	0.20	.0080	.0030	.0100	.0000	.38	5.6	....	.. .	0	[2]
11744	Nov. 11	Consid.	Mod. gray floc.	Earth veg.	0.35	.0010	.0120	.0025	.0000	.08	2.4	....	....	+	+[1]
11745	Nov. 11	Mod. opal	V. slight	Sl. earth veg.	0.32	.0008	.0130	.0025	.0000	.10	3.2	..	...	+	+[2]
11746	Nov. 11	Mod. opal	Sl. fine floc.	Sl. veg.	0.25	.0026	.0140	.0050	.0000	.23	3 5	....	....	+	+[2]
11747	Nov 11	Consid.	Consid. bro. floc.	None	0.25	.0222	.0120	.0025	.0000	.20	3.6	....	....	+	+[2]
11789	Nov. 25	Slight	Sl. coarse	Earthy	0.40	.0010	.0124	.0025	.0000	.10	2.3	....	....	+	+[1]
11790	Nov. 25	Sl. opal	Sl. floc.	Earthy	0.08	.0008	.0080	.0025	.0000	.20	3.6	....	....	0	[2]
11791	Nov. 25	V. ft. opal	V. slight	Ft. earthy	0.06	0008	.0074	.0025	.0000	.10	3.2	....	....	0	[3]

[1] Intake at river.
[2] River and spring water (filtered).
[3] Spring water.

Results of Bacteriological Examination of Connecticut River Water and Water from a Spring as Supplied to West Lebanon.

The following examinations are of samples collected at various points in connection with the use of water from the Connecticut River and from a spring. At the commencement of use of river water instructions were given for the application of hypochlorite treatment. The earlier results however, as indicated by bacteriological examinations, were not satisfactory, and a visit to the plant by the chemist on November 29th revealed the fact

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that neither the filtration nor the chlorination was being applied properly. Not only were the two mechanical filters in use (pressure type) found to be entirely too small for the service exacted of them, but there was no provision whatever for subsidence following coagulation. Under the circumstances, so far as the filtration was concerned, any satisfactory degree of improvement of the water was out of the question. Although crudely applied the sterilization treatment was, however, adjusted so as to afford acceptable results, bacterially at least,—it being represented that resort to the river source would hardly be necessary for more than a very few days longer at most.

During the fall of 1914, however, it again became necessary to supplement the regular supply from the river. At this time, the hypochlorite equipment was improved and instructions given to install a settling basin. Meanwhile, plans have been made which, it is expected, will insure a more satisfactory auxiliary source by another season. In the future, any practice of resorting to the river source at times of shortage will not be tolerated, with the present filter equipment. (See special reports elsewhere.)

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Lebanon.

Bacteriological Examinations of Connecticut River Water.

Date of Collection	Source	Bacteria per c. c.		Colon Bacilli	
		Agar 37 deg.	Agar-Gelatin (20 deg. c.)	1 c. c.	10 c. c.
Nov. 17	Tap in village	3	125	0	0
Nov. 17	Filtered and treated water	10	1100	0	0
Nov. 17	Filtered only	8000	21000	+	+
Nov. 17	Intake at river	10000	25000	+	+
Nov. 24	Tap in village	100	4000	0	0
Nov. 24	Treated and filtered water	18	4280	0	0
Nov. 24	Filtered only	5000	310200	0	+
Nov. 24	Intake at river	25000	V. high	+	+
Dec. 1	Tap in village	10	204	0	+
Dec. 1	Filtered and treated water	12	300	0	+
Dec. 1	Filtered only		10000	0	+
Dec. 1	Intake at river	30000	64000	+	+
Dec. 9	Tap in village	3	93	0	0
Dec. 9	Filtered and treated water	4	20	0	0
Dec. 9	Filtered only	924	2300	+	+
9	Intake at river	1000	3200	+	+
Dec. 15	Tap in village	103	3300	0	0
Dec. 15	Filtered and treated water	40	1200	0	0
Dec. 22	Tap in village	18	350	0	0
22	Filtered and treated water	30	1430	0	0
Dec. 30	Tap in village	18	.....	0	0

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Lincoln.—J. E. Henry & Sons Company furnish water from a stream.

Examination of Water from Henry Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10941	1913 Apr. 23	Slight	Sl brown floc.	V. sl. marsh	0.10	0010	.0016	.0050	.0000	.05	0.8	....	....	0	....
12052	1914 Apr. 27	None	Sl. floc.	None	0.13	.0006	0040	.0030	.0000	.05	0.1	....	....	0	0

Lisbon.

Examination of Water from the Lisbon Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10934	1913 Apr. 22	Sl. opal	None	V. sl. foul	0.15	0010	.0062	.0100	.0000	.07	1.9	....	....	0	....
12004	1914 Apr. 15	Sl. opal	Sl. earth	Sl. earth	0.08	.0008	.0060	.0050	.0000	.06	1.1	....	....	0	0
12005	Apr. 15	V. slight	V. slight	Ft. swampy	0.10	.0008	.0058	.0050	.0000	.05	1.1	....	....	0	0
12538	Aug. 29	Heavy opal	Consid. earth	Ft. mouldy	0.25	.0008	.0170	.0020	.0000	.08	2.2	....	....	0	0

*Examination of Water from *Springs of Merrill & Sanborn Supplying Hotel Lookoff, Sugar Hill.*

11420	1913 Aug. 13	None	None	Sl. foul	0.00	.0006	.0010	.0050	.0000	.08	1.4	....	....	+	....
11675	Oct. 15	None	None	None	0.0	.0006	.0014	.0100	.0000	.37	1.9	....	...	0	....
11910	1914 Feb. 17	None	None	None	0.03	.0006	.0010	.0050	.0000	.60	1.9	....	..	0	....
12378	July 16	None	None	None	0.00	.0006	.0014	.0030	.0000	.07	2.7	....	....	0	....

*Two different sources, undesignated.

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Littleton.—The town system is from the north branch of Gale River, conveyed a distance of nineteen miles through a conduit varying from sixteen to ten inches in diameter. There are two distributing reservoirs of 1,000,000 and 500,000 gallons respectively.

Examination of Water from the Littleton Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10923	1913 Apr. 18	None	V. slight	None	0.07	.0010	.0020	.0025	.0000	.03	0.1	.010	....	0	....
11501	Sept. 27	None	None	None	0.03	.0010	.0020	.0050	.0000	.05	0.1	....	....	0	....
12067	1914 May 1	None	V. slight	None	0.18	.0006	.0028	.0059	.0000	.04	0.1	.010	....	0	0

Examination of Ice Supply of Town of Littleton.

10452	1912 Sept. 3	V. slight	V. sl. coarse	Sl. earth	0.15	.0010	.0010	.0050	.0000	.03	2.3	....	....	+	1
11043	1913 May 21	Ft. opal	V. slight	Si. arom.	0.03	.0010	.0010	.0050	.0009	.05	0.0	....	....	0	2

[1]Water from small pond fed by brook, on the banks of which hogs are pastured.
[2]Ice, cut therefrom.

Londonderry.

Examination of Water from Spring of W. P. Mack Supplying Glenwood Farm.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11310	1913 July 28	None	V. slight	None	0.00	.0010	.0010	.3000	.0000	1.70	1.2	....	....	0	....

Examination of Water from Spring of W. E. Barrett Supplying Barrett Farm.

11314	1913 July 28	Sl. opal	Sl. earth	Sl. earth	0.05	.0006	.0010	.0050	.0000	.10	1.4	....	....	0	....

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Examination of Water from Well of Wm. McKay Supplying Ferndale Farm.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11315	1913 July 28	None	None	None	0.05	.0010	.0010	.1500	Ft. tr.	.85	4.6	....	....	0	....

Lyme.—The gravity supply of the Lyme Aqueduct Company is from springs.

Examination of Water from Supply of the Lyme Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10917	1913 Apr. 17	V. slight	Sl. white floc.	None	0.05	.0014	.0066	0150	.0000	.10	2.0	.020	....	0	....
12102	1914 May 11	None	None	None	0.00	.0006	.0014	.0030	.0000	.06	2.4	.015	....	0	0

Manchester.—Source of city supply, Lake Massabesic; main reservoir, 15,000,000 gallons; low service by gravity; high service from 4,000,000 gallon reservoir; 110 miles distributing mains; service pipes, lead-lined iron; average daily consumption, 3,500,000 gallons.

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Examination of Water from Lake Massabesic and Tributaries.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10543	1912 Oct. 8	None	None	None	0.18	.0010	.0090	.0050	.0000	.23	0.4	...	....	+	....
10720	1913 Jan. 22	None	V. slight	Sl. marsh	0.35	.0012	.0124	.0050	.0 00	.25	0.3	....	....	0	....
10722	Jan. 23	V. slight	V. slight	Mark veg.	0.35	.0010	.0130	.0050	.0000	.25	0.3	....	....	0	[2]
10784	Feb. 24	V. slight	V. slight	Sl. marsh	0.35	0010	.0140	.0025	.0000	.15	0.1	....	....	0	[2]
10785	Feb. 24	V. slight	V. slight	Sl. marsh	0.30	.0010	.0150	.0025	.0000	.18	0.1	....	....	0	[2]
10898	Apr. 14	D. red sediment	Heavy	Linseed	0.45	V. high	V. high	.0100	.0000	1.50	1.5	.300	....	0	[2]
11185	June 23	Slight	Slight	Strong arom.	0.35	.0010	.0090	.0050	.0000	.23	0.1	.000	....	0	....
11605	Sept. 17	V. slight	Sl. gray floc.	None	0.25	.0006	.0124	.0050	.0000	.18	0.4	....	....	0	[2]
11606	Sept. 17	V. slight	Slight	Sl. swamp	0.30	.0010	.0134	.0050	.0000	.16	0.4	....	+	0	[2]
11824	Dec. 15	None	Sl. white floc.	Sl. earth	0.15	.0014	.0068	.0025	.0000	.18	0.3	....	....	0	+[4]
11919	1914 Feb. 23	V. slight	Mod. ferrug.	Sl. swamp	0.65	.0014	.0180	.0100	Tr.	.30	1.1	.020	....	0	0
11952	Mar. 16	Sl. opal	V. slight	Ft. swamp	0.55	.0018	.0102	.0050	.0000	.20	0.7	....	....	0	0
12175	June 1	None	V. slight	None	0.45	.0022	.0134	.0050	.0000	.19	0.3	....	....	0	+[3]
12176	June 1	None	Sl. floc.	None	0.45	.0026	.0136	0050	.0000	.18	0.3	....	....	0	+[3]
12233	June 18	Slight	Sl. fine earth	Sl. marsh	0.45	.0016	.0124	.0050	.0000	.20	0.6	....	....	+	+[5]
12234	June 18	V. slight	V. sl. fine	V. slight	0.40	.0014	.0110	.0030	.0000	.19	0.3	....	....	0	+[3]
12235	June 18	Slight	Sl. gelat.	Sl. arom.	0.45	.0016	.0118	.0030	.0000	.18	0.3	....	....	+	+[6]
12357	July 14	V. slight	Mod. fine	V. slight	0.38	.0010	.0103	.0030	.0000	.15	0.1	....	....	0	0[7]
12356	July 14	Slight	Mod. floc.	None	0.35	.0014	.0106	.0030	.0000	.14	0.1	....	....	0	0[8]

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Examination of Water from Lake Massabesic—Continued.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1914														
12358	July 14	Slight	Sl. floc.	V. slight	0.50	.0018	.0134	.0030	.0000	.17	0.1	...	....	0	0[1]
12393	July 20	Slight	Mod. floc.	Slight	0.35	.0016	.0128	.0030	.0000	.19	0.3	....	....	0	0[2]
12394	July 20	Mod.	Mod. floc.	Arom.	0.55	.0014	.0134	.0050	.0000	.56	1.5	....	....	0	0[3]
12395	July 20	Slight	Consid. brn. floc.	Sl. arom.	1.10	.0016	.0200	.0030	.0000	.17	0.6	....	...	0	0[9]
12396	July 20	Mod.	Con. floc. gelat.	Swamp.	2.20	.0050	.0420	.0030	.0000	.18	1.1	...	.. .	0	0[10]
12397	July 20	Slight	Mod. floc.	None	0.45	.0044	.0160	.0030	.0000	.30	1.2	...	...	0	0[8]
12398	July 20	Slight	Mod. floc.	None	0.40	.0020	.0144	.0030	.0000	.18	0.1	...	....	0	0[8]

[1]Front pond.
[2]High service reservoir.
[3]Low service reservoir.
[4]Emery brook.
[5]Brook (near station).
[6]Canal.
[7]Back Pond.
[8]Neil brook (near highway.
[9]Sucker brook.
[10]Merrill brook.

Examination of Ice, Supply of Maxwell Ice Co.

	1913														
10801	Mar. 6	V. slight	Sl. fibre	V. sl. earth	0.00	.0030	.0010	.0025	.0000	.03	0.0	.. .	....	0	....
	1914														
12088	May 7	None	Slight	Slight	0.02	.0022	.0030	.0030	.0000	.03	0.0	....	....	0	0[1]

[1]As Supplied to Boston & Maine Railroad, ut from Black Brook.

Examination of Ice Supply of Manchester Coal and Ice Company.

	1913														
10802	Mar. 6	V. slight	Sl. earth	Sl. veg.	0.00	.0080	.0020	.0025	.0000	.03	0.0	....	....	0	[1]
10803	Mar. 6	V. slight	Mod. fibre	Veg.	0.00	.0030	.0020	.0025	.0000	.03	0.0	...	....	0	0[2]
10824	Mar. 24	V. slight	V. sl. fibre	None	0.00	.0010	.0015	.0025	.0000	.04	0.0	....	....	0	0[1]
	1914														
12088	May 7	None	V. slight	None	00	.0010	.0020	.0030	.0000	.03	0.0	....	....	0	0[3]

[1]Massabesic Lake.
[2]Nutt Pond
[3]As supplied Boston & Maine Railroad, from Massabesic Lake.

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*Examination of Water and Ice from *Pond of James Light stone (at Hooksett Line; ice to be sold in Manchester).*

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11839	1913 Dec. 30	V. slight	V. slight	.....	0.80	.0010	.0126	0050	Ft. tr.	.10	0.4	....	....	+	+[1]
11964	1914 Mar. 9	None	V. slight	None	0.06	.0010	.0026	.0030	.0000	.03	0.0	....	....	0	0[2]

[1] Water.
[2] Ice.
*Following an inspection by the Board certain changes in drainage disposal were effected.

Examination of Water from Pond owned by J. B. Bolduc. (Proposed source of ice supply.)

11825	1913 Dec. 15	Mod. opal	Sl. fine	Earthy	0.80	.0022	.0194	.0050	.0000	.40	0.9	....	....	0	....

Examination of Water from Well of Manchester Light & Traction Company, Supply of Hotel on Uncanoonuc Mountain.

11691	1913 Oct. 18	None	None	Decid. veg	0.05	.0050	.0074	.0050	High	.08	3.3	....	....	0	....

Marlborough.—The W. H. Aldrich system furnishes water to a small number of families from a spring.

Examination of Water from Spring owned by White Heirs.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10682	1912 Dec. 19	Mod. opal	V. slight	None	0.15	.0070	.0020	.0025	.0000	.05	1.9	....	....	0	....

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Examination of Water from Supply of W. H. Aldrich.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10683	1912 Dec. 19	Slight	Mod. earth	None	0.15	.0005	.0070	.0025	Ft. tr.	.15	4.6	0.50	....	0	....
10795	1913 Mar. 5	Slight	Mod. grey floc.	None	0.07	.0006	.0010	.0200	.0000	.25	0.9	0.30	....	0	....

Examination of Water from Well of W. A. Moors.

10717	1913 Jan. 20	None	None	None	0.00	.0010	.0010	.0025	.0000	.10	0.6	0.50	....	0	....

Examination of Water from Spring of Collins & Richardson.

10721	1913 Jan. 21	None	V. slight	None	0.00	.0012	.0018	.0200	.0000	.15	1.2	0.30	....	+	....

Examination of Water from Well of Methodist Church.

10796	1913 Mar. 3	Slight	Mod. earth	Earthy	0.15	.0010	.0110	.0250	.0000	2.45	2.6	.010	....	0	....

Meredith.—The precinct system consists of a gravity supply from springs and a stream.

Examination of Water from Supply of the Meredith Fire District.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10962	1913 Apr. 29	Sl. opal	V. slight	None	0.10	.0010	.0070	.0050	.0000	.10	0.3	....	....	0	....
12075	1914 May 7	None	None	None	0.04	.0010	.0040	.0030	.0000	.11	0.4	....	....	0	0

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Examination of Water from Spring of C. N. Roberts.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10976	1913 May 21	Slight	Sl. coarse veg.	V. slight	0.07	.0006	0010	.0025	.0000	.03	0.4	....	....	0	....

Examination of Water from Spring of Eben Lincoln Supplying Prospect House.

11339	1913 July 30	Ft. opal	V. slight	None	0.05	.0006	.0010	.0025	Tr.	0.7	1.2	.075	....	+	....

Examination of Water from Wells of Austin Moulton Supplying The Elmwood.

11334	1913 July 30	Sl. opal	V. slight	Slight	0.05	.0010	.0010	.0200	.0000	.35	2.3	....	....	+	....
11336	July 30	None	None	None	0.05	.0010	.0010	.0500	Tr.	.07	2.0	....	....	+	....

Examination of Water from Spring of J. R. Lovett Supplying Grampian House.

11344	1913 July 31	Sl. opal	Slight coarse	None	0 05	.0006	.0010	.0025	.0000	.04	0.7	.075	..	0	....

Merrimack.—The public water system supplying Merrimack village and owned by the United Realty Company is taken directly from the Souhegan River, a polluted source. As a result of a recent inspection and order by the Board, a new system from driven wells is to be installed at once. (See special report elsewhere.)

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Examination of Water from Supply of United Realty Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11855	1914 Jan. 5	V. slight	V. slight	V. sl. swamp	0.30	.0014	.0096	.0050	.0000	.25	0.4	....	....	0	+[1]
11856	Jan. 5	V. slight	Sl. fine veg.	Sl. swamp	0.30	.0010	.0090	.0050	.0000	.25	0.4	....	....	0	+[2]
12089	May 8	Slight	Sl. floc	Marshy	0.38	.0012	.0084	.0050	.0000	.25	0.3	...	....	+	+[1]
12308	July 2	Mod.	Mod. floc	None	0.05	.0026	.0146	.0030	.0000	.24	0.9	....	....	+	+[3]
12464	Aug. 11	V. slight	V. slight	Sl. earth	0.03	.0020	.0026	.0030	.0000	.08	0.3	....	...	0	0[4]

[1] Intake in Souhegan River.
[2] Souhegan River, 150 yards above intake.
[3] Tap
[4] Spring, possible public supply.

Milford.—The town system consists of three wells, the water being pumped to a 250,000-gallon standpipe.

During 1913 there was some shortage, and samples were submited from a stream under consideration as an auxiliary source. Apparently it has not as yet been found necessary to have recourse to the latter; upon notifying the local officials of the law which, under a maximum penalty of one thousand dollars, requires securing the formal approval of the Board before adoption of any new source, it was replied that while this source was under consideration, it had not thus far been found necessary to resort to it.

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Examination of Water from Faucet of Milford Water Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10966	1913 April 21	V. slight	Sl. fine	None	0.15	.0010	.0080	.0050	.0000	.12	0.6	....	....	0	....
11213	July 9	V. slight	Sl. fine	Dist. arom.	0.55	.0010	.0150	.0050	.0000	.13	0.3	....	....	0	...[3]
11214	July 9	None	None	None	0.18	.0010	.0038	.0050	.0000	.14	0.6	....	....	0	....
61296	July 24	V. slight	Mod. fine veg.	Dist. musty	0.45	.0014	.0150	.0050	.0000	.11	0.3	....	....	+	...[1]
11297	July 24	Sl. fine	Sl. br'wn floc	Sl. veg.	0.45	.0014	.0140	.0050	.0000	.10	0.1	....	....	0	...[2]
11298	July 24	V. slight	Sl. br'wn floc	V. sl. veg.	0.45	.0014	.0156	.0050	.0000	.10	0.1	....	....	0	...[3]
1 1977	1914 April 1	Mod. opal	Sl. earth	Sl. earth	0.45	.0010	.0036	.0050	.0000	.14	1.2	....	....	0	0
11998	April 13	V. sl. opal	V. sl. fine	None	0.15	.0010	.0054	.0050	.0000	12	1.4	....	....	0	0

[1] Stream 600 ft. above Pumping Station.
[2] Stream 300 ft. above Pumping Station.
[3] Stream, proposed emergency intake.

Examination of Water from Well of French & Heald Co.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10899	1913 May 12	V. sl. opal	None	None	0.05	.0020	.0024	.0050	Bl'h	0.45	3.9	....	....	0	....

Moultonborough.

Examination of Water from Well of A. S. Freese, Supplying Maple Hurst.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11333	1913 July 31	Sl. opal	V. slight	None	0.07	0010	.0030	0750	Ft. trac.	2.00	7.9	..	..	0	...

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Examination of Water from Spring of E. C. Kent, Supplying Red Oaks.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11335	1913 July 31	None	None	None	0.05	.0006	.0006	.0050	.0000	.05	1.6	.075	....	+	....

Examination of Water from Well of W. D. Robinson, Supplying Prospect Cottage.

11340	1913 July 30	None	V. slight	None	0.05	.0010	.0100	.1000	.0000	2.90	8.9	....	....	0	....

Examination of Water from Well of Ernest Davis, Supplying Pleasantdale.

11345	1913 July 31	None	V. slight	Arom.	0.05	.0006	.0010	.0025	.0000	.05	1.7	....	....	+	..

Nashua.—The Pennichuck Water Works furnishes water from springs and artesian wells. The water is accumulated in a large natural open basin, from which it is pumped to a distributing reservoir of 4,000,000 gallons. Daily consumption, 2,750,000 gallons.

Examination of Water from Supply of Pennichuck Water Works.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11027	1913 May 17	V. slight	V. slight	Dist m'st earthy	0.07	.0010	.0060	.0025	.0000	.18	2.2	....	Ft. tr.	0	....
11368	Sept. 9	None	V. slight	Earthy	0.05	.0006	.0024	.0050	.0000	.20	1.9	000	....	0	....
12161	1914 May 27	None	None	Dist. veg.	0.05	.0006	.0026	.0050	.0000	.16	1 6	....	....	0	0

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Examination of Ice, Supply of Geo. E. Balcom Ice Co., Supplied to Boston & Maine Railroad.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12,243	1914 June 17	V. slight	Sl. flbu.	None	0.00	.0006	.0020	.0030	.0000	.05	0 0	....	....	0	0

Examination of Ice Cut from Sandy and Ottarnic Ponds.

12,279	1914 June 24	Consid. opal	V. slight	V. sl. marsh	0.00	.0006	.0014	.0030	.0000	.04	0.0	....	....	0	...[1]
12,280	June 24	Slight	Sl. flbu.	None	0.00	.0006	.0010	.0030	.0000	.05	0.0	....	....	0	...[2]

[1] Sandy Pond. [2] Ottarnic Pond

Examination of Water from Well of Alphonse Rioux.

10,523	1913 Aug. 28	Consid. white	Consid. gelot.	Veg.	0.35	V. high	Hlh.	1.500	V. high	5.00	8.9	....	C'n sid.	0	....

New Boston.—The Burnham Hill Water Company furnishes water to its stockholders from wells located in grass land. The abnormal contents of nitrate and chloride indicate some seepage, resulting from applied manure or fertilizer.

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Examination of Water from Supply of Burnham Hill Water Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12,017	1914 April 13	None	None	Sl. foul	0.05	.0008	.0018	.2500	.0000	1.10	6.0	.050	....	0	....
12 069	May 5	None	Sl. earth	None	0.02	.0006	.0030	.0300	.0000	.37	2.6	....	....	0	0
12,070	May 5	V. sl. opal	V. slight	V. sl. earth	0.00	.0006	.0028	.0500	.0000	.46	2.6	.010	....	0	0
12 071	May 5	None	V. sl. silt	None	0.08	.0008	.0074	.1000	.0000	1.30	4.9	.005	....	0	0
12,072	May 5	Sl. opal	Sl. floc.	V. slight	0.02	.0010	0064	.250	.0000	1.70	5.9	.005	...	0	0
12,073	May 5	None	V. sl. earth	None	0.00	.0008	.0022	.1500	.0000	.85	4.0	.010	....	0	0

New Durham.

Examination of Water from Merry-meeting Lake, Source of the New Hampshire Water Supply Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10805	1913 Mar. 9	Slight	V. slight	Sl. veg.	0.07	.0015	.0060	.0025	.0000	.18	0.3	....	....	0	....

New Hampton.—The precinct operates a gravity system from a pond, through a distributing reservoir of 5,000,000 gallons.

Examination of Water from Precinct Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10956	1913 Apr. 28	None	None	Ft. earth	0.10	.0014	0054	.0025	.0000	.09	0.1	....	....	0	....
12103	1914 May 10	None	None	None	0.07	.0008	0014	.0030	.0000	.08	0.1	...	....	0	0

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New Ipswich.

Examination of Water from Well of James Roger, Used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11003	1913 May 12	None	None	None	0.05	.0006	.0050	.005	.0000	.25	3.5	.030	....	0	...

New London.—The C. E. Shepard supply is from two drilled wells, the water being pumped to a 30,000-gallon reservoir.

Examination of Water from Shepard Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10932	1913 May 9	None	V. slight	None	0.05	.0010	0110	.0025	.0000	.05	2.6	....	....	0	....

Examination of Well Supplying Colby Academy.

10731	1913 Jan. 25	None	None	Sl. earth	0.05	.0014	.0010	.0750	.0000	1.65	8.9	....		0	....

Examination of Water from Kings Hill Brook.

11996	1914 Apr. 13	V. slight	Slight	Sl. swamp	0.27	.0066	.0080	.0050	.0000	.07	0.7	....	....	0	0

Newmarket.—The town system consist of water pumped from Follet's Creek to a 22,000-gallon standpipe. During 1913–14 three deep drilled wells were constructed near the brook intake, but this water has not as yet been turned into the system. (See special report elsewhere.)

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Examination of Water from Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10943	1913 Apr. 15	Consid. opal	V. sl. fine	Consid. earth	0.55	.0010	.0080	.0250	.0000	.30	1.4	....	....	0	....
12107	1914 May 13	Mod. opal	Mod. fine	None	0.30	.0010	.0140	.0200	.0000	.23	1.6	0.05	....	+	+
12137	May 20	Mark. opal	None	None	0.00	.0008	.0016	.0070	.0000	.42	2.4	....	.010	0	0[1]
12162	June 1	None	V. slight	V. sl. foul	0.00	.0006	.0014	.0600	.0000	.43	2.2	....	....	0	0[2]
12549	Aug. 31	Consid. opal	Sl. fine	Ft. arom.	0.25	.0030	.0100	.0400	.0000	.40	2.2	....	....	0	0

[1] Artesian well.
[2] Brailey Spring.

Examination of Water from "Towles Well."

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12548	1914 Aug. 31	None	V. slight	None	0.03	.0008	.0030	.7000	Tr.	1.90	6.7	...	....	+	....

Newport.—A gravity system owned by the town supplies water from a pond. Some cement-lined service pipe used.

Examination of Water from Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10964	1913 Apr. 30	V. sl. opal	Sl. earth	Ft. earth	0.15	.0010	.0070	.0050	.0000	.10	0.1	....	....	0	...
12181	1914 June 3	None	V. slight	Earthy	0.10	.0010	.0088	.0030	.0000	.09	0.4	....	....	0	+
12500	Aug. 18	Slight	Sl. floc.	....	0.07	.0006	.0050	.0050	.0000	.08	0.4	....	....	0	....

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Newton.

Examination of Water from Well Supplying School.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10352	1912 Oct. 15	None	None	Earthy	0.05	.0020	.0015	3000	High	3.20	11.8	....	....	+	....

North Hampton.

Examination of Water from Artesian Well Supplying School.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10533	1912 Oct 3	Heavy opal	Mod. ferrug.	None	0.30	.0010	.0015	.0050	.0300	1.55	7.4	....	....	0	....

Examination of Water from Artesian Well Supplying Hotel.

11610	1913 Sept. 17	None	None	Sl. arom.	0.05	.0010	.0024	.1750	High	7.65	8.1	....	....	0	....
11622		None	Sl. white floc.	None	0.05	.0100	.0054	.0100	Ft. tr.	8.45	6.0	....	....	0	....

Northumberland.—Groveton village precinct is supplied with water by a gravity system from mountain streams.

Examination of Water from Groveton Village Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10960	1913 April 30	None	None	None	0 15	.0006	.0030	.0025	.0006	.05	0.1	....	....	0	....
12163	May 28	None	V. sl. floc.	None	0.00	.0012	.0026	.0030	.0000	.05	0.3	....	....	0	0

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Examination of Water from River.
(Numerous lumber camps at source.)

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11922	1914 Mar. 2	V. slight	Mod. gray floc.	Earthy	0.25	.0042	.0074	.0100	.0000	.06	0.6	....	....	0	....

Ossipee.—A gravity system from ponds was installed during 1911 by the Ossipee Water and Electric Company.

Examination of Water from the Supply of the Ossipee Water & Electric Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11175	1913 June 21	Mod.	Mod. br. floc.	Earth	0.20	.0010	0060	.0050	.0000	.08	0.1	....	....	0	....
11411	Aug. 12	None	Slight	None	0.00	.0010	.0040	.0050	.0000	.05	0.3	....	....	0	....

Examination of Water from Spring of C. W. White, Supplying Mt. Whittier House.

11412	1913 Aug. 12	None	V. slight	None	0.05	.0006	.0010	.0050	.0000	.05	1.1	....	...	0	....

Examination of Water from Well of J. H. Graham, Supplying Hackmatack Farm.

11414	1913 Aug. 13	None	None	None	0.05	.0010	.0020	0100	.0000	.15	1.4	....	....	0	.. .

Examination of Water from Well of Mrs. Hattie Kershaw, Supplying "The Sunnyside House."

11415	1913 Aug. 13	None	None	V. slight	0.05	.0010	.0030	.0050	.0000	.35	1.9	....	. ..	0	...

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Examination of Water from Well of W. N. Connor, Supplying West Ossipee House.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11416	1913 Aug. 12	None	None	None	0.05	.0006	.0010	.1000	.0000	.18	1.9	....	....	0	...

Examination of Well of J. E. Hodgdon, Supplying Hackmatack Farm.

11417	1913 Aug. 13	Slight	Sl. floc.	Sweet	0.05	High	V. High	.2500	.0000	3.10	7.4	..	....	+	....

Examination of Water from Spring of Frank Hanson, Supplying Carroll Inn.

11428	1913 Aug. 13	V. slight	Sl. coarse	V. sl. earth	0.05	.0010	.0080	.2500	.0000	.65	1.9	..	....	0	....

Pembroke.—The leading supply of Suncook village is from a pond and brook. During 1914 the town of Pembroke acquired this system of the Suncook Water Works Company, and at this date has under construction a system having its source in Pleasant Pond, Deerfield, such being designed to supply Pembroke, Suncook, Allenstown, and probably eventually other neighboring localities. (See special report elsewhere.)

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Examination of Water from Supply of Suncook Water Works.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10771	1913 Feb. 20	Slight	None	Marsh	0.80	.0010	.0085	.0050	.0000	.18	0.1	....	...	0	....
11062	May 28	V. slight	Slight	Arom.	1.40	.0010	Hi'h	.0100	.0000	.15	0.1	..	....	0	....
11472	Aug. 15	Slight	Sl. floc.	Arom.	0.60	.0010	.0110	.0050	.0000	.17	0.1	....	....	+	....
12157	1914 May 25	V. slight	V. sl. floc.	V. sl. swamp	0.60	.0086	0000	.0020	.0000	.15	0.1	....	....	0	+[1]
12153	May 25	Slight	Sl floc.	Dist. swamp	0.40	.0033	.0123	.0030	.0000	.16	0.1	....	....	0	0[2]
12152	May 25	Slight	Sl. floc.	Dist. arom.	1 00	.0020	.0162	.0020	.0000	.16	0 1	...	....	0	0

[1]Cold spring reservoir.
[2]Bear Hill pond.

Examination of Water from Pleasant Pond, Deerfield, Source of New Public Supply for Pembroke.

10765	1913 Feb. 15	V. slight	V. slight	V. sl. marsh	0.05	.0010	.0110	.0050	.0000	.30	0.7	....	. ..	0	....

Examination of Water from Artesian Well Supplying Pembroke Sanatorium.

11576	1913 Sept. 11	Consid.	Mod. floc.	Sl. earth	0.20	.0004	.0008	.0050	.0000	.20	1.9	. ..	300	0	....

Examination of Water from Well Supplying Congregational Parsonage.

11509	1913 Aug. 29	Heavy opal	Sl. earthy	Slight	0.10	.0010	.0030	.0075	.0000	1.20	4.6	...	....	0	....

Peterborough.—Gravity system owned by town. Source, pond and brook. Service pipes, cement-lined iron.

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Examination of Water from Tap of Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10715	1913 Jan. 11	.....	.....	.....	....	....	....	....	.....	...	....	.060	....	0	....
10959	Apr. 30	Slight	Sl. floc.	None	0.45	.0010	.0090	.0050	.0000	.10	0.1	....	....	0	....
11023	May 12	Consid. floc.	Mod. floc.	V. slight	0.08	.0010	.0116	.0050	.0000	.05	0 1	....	....	0	....
12010	1914 April 15	V. slight	Sl. floc.	Sl. veg.	0.20	.0008	.0048	.0050	.0000	.06	0.1	....	....	0	0
12136	May 18	V. sl. opal	Mod. floc.	V. sl. veg.	0.10	.0010	.0184	.0100	.0000	.05	0.3	....	....	0	+

Examination of Water from Supplies owned by MacDowell Memorial Association.

11272	1913 July 21	None	V. slight	Sl. earth	0.05	.0006	.0010	.0500	Ft. tr.	.10	1.9	....	....	0	[1]
11273	July 21	V. ft. opal	None	None	0.00	.0010	.0016	.0750	.0000	2.45	1.2	.010	....	0	[2]
11274	July 21	None	Mod. silt.	None	0.05	0006	.0010	.500	Hi'h	.30	6.0	...	..	0	[2]
11275	July 21	Ft. opal	V. sl. opal	None	0.00	.0006	.0015	.0500	.0000	.20	1.9	....	....	0	[2]

[1] Spring.
[2] Well.

Pittsfield.—The gravity system of the Pittsfield Aqueduct Company is supplied from a pond. Distributing reservoir, 1,500,000 gallons. Service pipes, cement-lined and galvanized iron.

Examination of Water from the Pittsfield Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10958	1913 Apr. 30	Mod. opal	Sl. earthy	None	0.07	.0010	.0060	.0050	.0000	.15	0 3	....	....	0	....
12128	1914 May 15	V. slight	Sl. fine	Sl. earth	0.08	.0010	.0050	.0040	.0000	.15	0.3	....	...	0	+

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Plainfield.—The original source of the Meriden Water Company was in some springs and wells, with gravity flow. During 1913 this source went practically dry and recourse was had to a brook. The latter water is of excellent quality. (See special report elsewhere.)

Examination of Water of Meriden Water Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10957	1913 Apr. 30	None	Sl. floc.	None	0.05	.0010	.0010	.0025	.0000	.08	2.2	.. .	app.	0	[1]
11595	Sept. 17	None	V. slight	None	0.05	.0002	.0050	.0010	.0000	.07	1.6	....	....	0	0[2]
12101	1914 May 11	Sl. opal	Mod. earth	Sl. earth	0.02	.0030	.0052	.0030	.0000	.07	1.9	...	...	0	0[1]

[1]Spring and well supply.
[2]Brook.

Plymouth.—Gravity system owned by town from series of springs and wells. Distribution from two reservoirs having a capacity of 4,000,000 gallons. Recently two or three large dug wells were constructed on the intervale between the Pemigewasset and Baker Rivers, near the peg mill, the water being pumped into the mains. While thus far the water has proved to be of excellent quality, there are some objectionable features in connction with the surroundings. (See special report elsewhere.)

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Examination of Water from Town Supply

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10940	1913 Apr. 24	None	V. sl. fine	V. sl. earth	0.10	.0006	.0030	.0050	.0000	.07	1.1	...	....	0	....
12007	1914 Apr. 15	None	V. sl. earth	Strong earth	0.02	.0008	0016	.0050	.0000	.06	1.6	...	....	0	0[1]
12008	Apr. 15	None	V. slight	Dist. earth	0 00	0008	.0012	.0050	.0000	.07	1.8	....	....	0	+[1]
12009	Apr. 15	V. ft. opal[1]	V. slight	None	0 18	0006	.0040	0050	.0000	.08	1.5	....	....	0	0[2]
12053	Apr. 23	None	V. slight	None	0.00	.0006	.0016	.0010	.0000	.06	0.9	....	....	0	+[2]
12054	Apr. 28	None	V. slight	None	0.00	0006	.0016	.0010	.0000	.06	0.9	....	....	0	0[1]

[1]Pump at peg mill, lower well supply.
[2]Pump at peg mill, lower wells not turned on.

Examination of Water from Well of F. H. Caldon, Supplying "The Elmwood."

11458	1913 Aug. 11	None	V. slight	V. slight	0.05	.0010	.0030	.0050	.0000	.03	1.1	.. .	....	0	....

Portsmouth.—The city supply is derived from springs and wells, pumped to a standpipe of 500,000 gallons. Of late the supply has been inadequate and plans are now under consideration for securing more water.

Examination of Water from Portsmouth Water Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10749	1913 Feb. 7	Mod. opal	Sl. earth	Sl. veg.	0.03	.0010	.0030	.0100	.0000	.85	3.2	....	....	0	....
10990	May 8	None	V. slight	None	0 00	.0010	.0020	.0100	.0006	.65	6.7	....	....	0	....
12272	1914 June 23	None	None	None	0.05	·0006	.0014	·0200	.0000	.60	7.4	....	....	0	0

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Examination of Water from Well of L. W. Thompson, Used by Public.

Number	Date of Collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11070	1913 May 25	Slight	Sl. coarse	Earth	0.20	.0054	.0105	.2500	.0000	1.20	3.9	....	....	0	....

Examination of Water from Well belonging to City, and Used by Campers.

11072	1913 May 25	V. slight	Slight	Greasy	0.07	.0100	V. high	.2000	.0000	1.20	2.0	....	....	0	....

Examination of Water from Well of John Yarwood, Used by Public.

11405	1913 Aug. 16	None	V. slight	Slight	0.05	.0014	.0020	.0750	High	1.50	12.4	0	...	0	....

Examination of Water from Well of Harry H. Woods, Used by Public.

12238	1914 June 13	V. sl. opal	Sl. gelat.	V. slight	0.05	.0008	0028	.2000	.0000	8.60	8.9	...	....	0	....

Raymond.—The town water system consists of driven wells forty to sixty feet deep, the water being pumped to a standpipe of 120,000 gallons. For some years the analyses of this supply have been unsatisfactory, the excessive chloride and nitrate contents pointing to a direct relation with some contamination source.

Examination of Water from Raymond Supply.

Number	Date of Collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10942	1913 Apr. 25	V. slight	None	None	0 05	.0015	.0020	3000	Dist. tr.	2.90	5.0	....	....	0	....
11446	Aug. 18	None	None	None	0.05	.9010	.0020	225	.0000	2.00	4.6	....	....	0	....
12105	1914 May 13	None	None	None	0.03	.0010	0028	.225	0000	2.30	4.3	....	....	0	0

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Rochester.—The city water supply consists of a gravity system having its source in a pond.

Examination of Water from Rochester Supply.

Number	Date of Collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10961	1913 Apr. 30	Slight	Slight fine	Sour	0.45	.0010	.0100	.0025	.0000	.11	0.3	....	....	0	....
12027	1914 Apr. 22	Sl. opal	V. slight fine	Earth	0.35	.0020	.0140	.0050	.0000	.17	0.4	....	....	0	0

Examination of Water from Well owned by Spaulding Bros., Used by Public.

11279	1913 July 22	Sl. opal	None	None	0.07	.0010	.0015	.1500	Trc.	1.70	3.2	.075	....	0	....

Examination of Water from Well of Smalley & Huntress, Used by Public.

11422	1913 Aug. 15	None	None	None	0.05	.0010	.0040	.5000	.0000	2.10	5.3	.020	....	0	....

Examination of Water from Well of Boston Brick Co., Used by Public.

11553	1913 Sept. 4	V. slight	Slight	None	0.05	.0030	.0030	.0050	.0000	.18	3.2	....	....	0	....

Examination of Water from Spring of J. B. Stevens, Sold to Public.

11555	1913 Sept. 5	None	None	None	0.03	.0010	.0010	.0050	.0000	.07	0.1	....	....	0	....

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Rollinsford.

Examination of Water from Wells of Salmon Falls Manufacturing Company.

Number	Date of Collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11189	1913 June 25	Mod. opal	V. slight	Veg.	0.07	.0020	.0070	.0200	.0000	.90	4.6	....	...	0	....
11511	Aug. 27	Mod. opal	V. slight	Earth	0.15	.0034	.0040	.0100	.0000	1.00	12.4	....	...	0	....
11878	1914 Jan. 29	None	None	None	0.05	.0010	.0070	1.0000	.0000	1.30	25.0	....	...	0	...[1]
11879	Jan. 29	None	None	None	0.05	.0012	.0066	1.0000	.0000	3.40	14.8	....	...	0	...[2]
11880	Jan. 29	None	None	V. sl. foul	0.05	.0010	.0060	.6000	.0000	7.00	12.4	..	...	0	...[3]
11881	Jan. 29	None	None	None	0.05	.0008	.0072	.5000	.0000	2.40	13.4	.010	...	0	...[4]

[1] Well in Mill Yard. [2] Well on Main Street.
[3] Well on Second Street. [4] Spring

Examination of Water from Public Well.

10885	1913 April 9	V. slight	V. slight	None	0.05	.0010	.0050	1.0000	.0000	12.0	12.4	...	...	+	....

Examination of Water from Well of John F. Goodwin, Used by Public.

10886	1913 April 9	None	None	None	0.05	.0010	.0040	1.0000	.0000	12.0	6.0	...	...	0	....

Examination of Water from Well owned by Alfred Parent and J. Q. A. Wentworth.

11188	1913 June 25	Sl. opal	Slight	V. slight	0.05	.0040	.0040	5.0000	Tr.	11.5	16.0	....	...	0	....

Examination of Water from Well of Francis Ham, Used by Public.

11510	1913 Aug. 27	V. slight	None	Sl. earth	0.05	.0010	.0020	.0030	.0000	.20	1.9	....	....	0	....

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Examination of Water from Well of W. F. McNally, Used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11512	1913 Aug. 27	None	None	Slight	0.10	.0010	.0060	1.0000	Hi'h	11.0	30.0	...	....	+	....

Rumney.

Examination of Water from Spring of Daniel Pillsbury.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12477	1914 Aug. 12	None	None	None	0.03	.0010	.0014	.0030	.0000	.08	2.0	....	....	0	....

Rye.

Examination of Water from Artesian, Well Supplying Ocean Wave House, Rye North Beach.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11211	1913 July 4	Mod. opal	V. slight	Sl. earth	0.10	Hi'h	0020	.5000	Tr.	112.0	8.1	...	...	0	....

Salem.—The town operates a gravity system, the source being Canobie Lake. (See special report elsewhere.)

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Examination of Water Taken from Town Supply.

Date of collection	Source	Residue		Ammonia		Chlorine	Hardness	Iron	Reaction of 100 c. c. with $\frac{N}{50}$ neutralizer, using:					
									Methyl Orange	Phenolphthalein				
										Cold		After Boiling		
		Total	Fixed	Free	Albuminoid									
1913														
11,246 July 16	V. slight	Sl. floc	Mark. arom.	0.18	.0010	070	.3050	0000	.45	0.3	...	....	0	....
1914														
12,177 May 29	None	None	None	0.13	.0014	.0106	.0050	.0000	.39	0.4	....	....	0	0

Salisbury.

Examination of Water from Wells at Webster Birthplace.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1913														
11350	Aug. 1	None	None	Sl. foul	0.05	.0010	.0060	.2000	Tr.	1.30	2.6	....	....	+	....
11351	Aug. 1	Mod.	Mod. grey floc.	Mark veg.	0.05	V'ry high	V'ry high	.3000	Hi'h	1.90	5.3	....	....	+	....
	1914														
12444	Aug. 4	None	Sl. floc.	None	0.03	.0006	.0050	.0050	Tr.	.85	3.1	...	....	0	....
12458	Aug. 10	Heavy opal	Mod. floc.	Mark veg.	0.50	.0240	.0220	.0030	.0000	.20	6.0	....	Md	0	1

[1]New Well.

Examination of Water from Well Used by Public.

	1912														
19679	Dec. 18	None	V. slight	None	0 05	.0010	.0030	.0750	.0000	1.90	4.6	....	....	0	....

Sandwich.

Examination of Water from Well of Frank Tilton, Supplying Rockmere Farm.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1913														
11423	Aug. 11	None	None	None	0.0	001	.00	.0050	.0000	.05	0.3	.010	....	0	....

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Examination of Water from New Well of C. O. Haley, Supplying Tilton House.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,338	1913 July 10	Heavy opal	Consid. br. floc.	Earth	0.20	.0110	.0050	.0050	Hi'h	.45	5.0	....	....	0	....

Examination of Water from Well of F. W. McLane, Supplying Sandwich House.

11342	1913 July 29	Ft. opal	None	Sl. foul	0.05	.0010	.0020	.2500	.0000	.70	5.0	....	....	+	....

Hart's Location.

Examination of Water from Spring Supplying Main Central Railroad at Sawyer's River.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12,200	1914 June 6	None	Slight	None	0.03	.0006	.0010	.0030	.0000	.06	0.6	....	....	0	0

Seabrook.

Examination of Water from Springs of C. E. Gore, Used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11911	1914 Feb. 19	Sl. opal	Sl. earth	Sl. foul	0.05	.0006	.0034	.0750	.0000	1.10	3.6	....	....	0	....
11929	Mar. 5	Sl. opal	V. slight	Sl. earth	0.10	.0020	0109	.0600	.0000	.95	2.9	...	....	0	....
11930	Mar. 5	Slight	V. slight	Sl. earth	0 10	.0008	.0014	.0400	.0000	1.18	3.0	..	Sl't	0	...

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Somersworth.—The city supply is taken from the Salmon Falls River. During 1912 an investigation of the filter plant having demonstrated its inadequacy for affording a safe supply, a system of sterilization based upon the use of liquefied chlorine gas was installed. (See elsewhere.)

Examination of Water Supplying Somersworth.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
	1912														
10643	Dec. 3	None	V. slight	Earthy	0.50	.0015	.0070	.0100	.0000	.20	1.4	....	....	+	....
10662	Dec. 9	V. slight	Mod. floc.	Mod. earth	0.70	.0015	.0150	.0050	.0000	.40	1.2	....	....	0	+[1]
10663	Dec. 9	None	None	Ft. earth	0.60	.0015	.0090	.0050	.0000	.40	1.4	....	....	0	+
10664	Dec. 12	None	None	None	0.55	.0015	.0100	.0050	.0000	.40	1.4	....	....	0	0
10665	Dec. 12	Mod.	Sl. gelat.	Sl. earth	0.70	.0010	.0130	.0050	.0000	.40	1.4	....	....	+	+[1]
10667	Dec .16	None	None	Sl. veg.	0.55	.0015	.0130	.0050	.0000	.80	2.7	....	....	0	+
10696	Dec. 30	None	None	Sl. marsh	0.50	.0010	.0130	.0050	.0000	.30	1.5	....	....	0	..
	1913														
10708	Jan. 13	Faint	V. slight	Sl. marsh	0.65	.0010	.0138	.0050	.0000	.35	2.2	....	....	+	....
10729	Jan. 23	None	V. slight	Sl. marsh	0.50	.0010	.0116	.0050	.0000	.30	1.5	....	....	+	....
10740	Feb. 3	None	V. slight	Marsh	0.50	.0010	.0110	.0100	.0000	.35	1.8	....	....	+	....
10743	Feb. 6	V. slight	Sl. fine	Marsh	0.55	.0016	.0120	.0050	.0000	.25	1.1	....	....	0	[2]
10832	Mar. 24	V. slight	V. slight	Sl. swamp	0.55	.0010	.0110	.0050	.0000	.30	1.2	....	....	0	....
10851	Mar. 31	Slight	V. slight	V. sl. swamp	0.55	.0010	.0086	.0100	.0000	.35	2.2	....	....	0	....
10965	Apr. 29	Mod.	Mod. gelat.	Sl. earth	0.60	.0010	.0166	.0010	.0000	.35	0.9	....	....	+	[1]
11116	June 9	Slight	Mod. veg.	None	0.65	.0010	.0110	.0050	.0000	.35	0.9	....	....	0	....
11496	Aug. 25	Sl. opal	V. slight	None	0.35	.0010	.0084	.0050	.0000	.33	1.9	....	....	0	....
11619	Sept. 24	None	None	None	0.30	.0014	.0080	.0050	.0000	.33	1.2	....	....	0	0
11748	Nov. 10	None	V. slight	Sl. swamp	0.55	.0010	.0160	.0050	.0000	.34	1.9	....	....	0	0
	1914														
11963	Mar. 23	None	V. sl. floc.	None	0.45	.0016	.0090	.0050	.0000	.26	1.1	....	....	0	0
12154	May 25	V. slight	None	None	0.40	.0014	.0084	.0050	.0000	.32	1.4	....	....	0	0
12329	July 8	V. slight	Slight	Sl. earth	0.45	.0030	.0100	.0030	.0000	.32	1.5	....	....	0	+
12469	Aug. 12	Mod.	Mod. veg.	V. slight	0.40	.0028	.0080	.0030	.0000	.32	1.9	....	....	0	0

[1] River direct.
[2] Salmon Falls River in Milton, above contaminative sources. Note that the degree of color is as high as at Somersworth. It has been claimed in the past that the discharge of leatherboard waste was largely responsible for the color.

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Bacterial Examination of the Somersworth Supply, Showing Results of Combined Filtration and Chlorine Treatment.

Date	Source.	Bacteria per cc.		Colon - bacilli.	
		at 37° C.	at 20° C.	(1 cc.)	(10 cc.)
1913.					
March 31	Screen well	9000		+	
	Filter well (untreated)	280		0	
	Boiler room	134		0	
	Grove St.	50		0	
April 10	Screen well	140		+	
	Boiler room	30		0	
	Hotel office	40		0	
	Back St.	68		0	
15	Screen well	480		+	
	Boiler room	42		0	
	Grove St.	84		0	
	Rochester St.	96		0	
21	Screen well			+	
	Boiler room	5		0	
	Grove St.	16		0	
	Rochester St.	16		0	
30	Boiler room	18		0	
	Mt. Vernon St.	24		0	
	Rochester St.	16		0	
	Grove St.	8		0	
May 6	Screen well	166		0	
	Boiler room	85		0	
	Rochester St.	23		0	
	Grove St.	8		0	
13	Screen well	180		+	
	Boiler room	18		0	
	Grove St.	28		0	
	Rochester St.	26		0	
21	Boiler room	27		0	
	Rochester St.	28		0	
	Grove St.	32		0	
27	Boiler room	24		0	
	Rochester St.	28		0	
	Grove St.	16		0	
June 12	Screen well	890		0	
	Boiler room	64		0	
	Rochester St.	48		0	
	Winter St.	98		0	
19	Screen well	270		+	
	Boiler room	38		0	
	Rochester St.	46		0	
	Grove St.	72		0	
July 17	Screen well	200	32290	+	
	Filter well (untreated)	170	28500	+	
	Boiler room	40	472	0	
	Boiler room	69	570	0	
29	Screen well	300	136500	+	
	Boiler room	12	1100	0	
	Boiler room	16	900	0	
	Rochester St.	45	1040	0	
Aug. 20	Screen well		74000	+	
	Boiler room	31	450	0	
	Rochester St.	75	600	0	
	Grove St.	132	750	0	

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Date	Source.	Bacteria per cc.		Colon bacilli	
		at 37° C.	at 20° C.	(1 cc.)	(10 cc.)
1913.					
Sept. 1	Screen well	.....	75000	+	.....
	Boiler house	25	244	0	.....
	Rochester St.	69	340	0	.....
	Grove St.	40	224	0	.....
9	Screen well	400	2400	0	.....
	Boiler room	1	3	0	.....
	Grove St.	16	60	0	.....
	High St.	4	40	0	.....
29	Screen well	.....	3700	+	.....
	Boiler room	12	.....	0	.....
	Rochester St.	4	14	0	.....
	Rochester St.	6	6	0	.....
Nov. 25	Screen well	210	630	+	+
	Filtered only	30	240	+	+
	Boiler room	1	30	0	0
	Rochester St.	1	20	0	0
Dec. 3	Screen well	200	800	+	+
	Filtered only	50	400	0	+
	Boiler room	1	5	0	0
	Rochester St.	2	4	0	0
1914.					
March 26	Screen well	36	1200	+	+
	Boiler room	6	10	0	0
	Grove St.	7	20	0	0
	Rochester St.	6	60	0	0
May 9	Screen well	190	700	+	+
	Filtered only	270	540	0	+
	Boiler room	4	10	0	0
	Grove St.	7	17	0	0
Aug. 4	Screen well	4500	480000	+	+
	Filtered only	4400	8240	+	+
	Boiler room	50	125	0	0
	Rochester St.	57	100	0	0

Results of Mechanical Analysis of Sands After Running Through Washer during Summer, 1912, Somersworth Filter Plant.

	Sample A. (per cent)	Sample B. (per cent)	Sample C. (per cent)
Equal to or coarser than 2.5 m. m.	5.0	4.0	4.5
Finer than 2.5 m. m.	95.0	96.0	95.5
Finer than 1.0 m. m.	63.0	61.0	62.5
Finer than 0.5 m. m.	22.0	17.0	20.0
Finer than 0.25 m. m.	5.5	4.5	5.5
Finer than 0.15 m. m.	0.5	0.5	0.6
Mean effective size, millimeters	0.32	0.36	0.33
Coefficient of uniformity	3.00	2.72	2.97

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Examination of Water from Well of Great Falls Manufacturing Co., Used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10763	1913 Feb 17	None	None	None	0.00	.0060	0020	.7000	Ft. tr.	8.95	12.4	....	....	0	....

Examination of Water from Well of Fred Whitehouse, Used by Public.

12331	1914 July 8	Sl. opal	White fibre	Sl. foul	0.05	0006	.0010	.0030	.0000	.55	3 9	....	....	0	....

*Examination of Water from Well of Mrs. Margaret H. Stanton.**

12506	1914 Aug. 19	None	None	None	0.03	.0008	.0014	1.250	Tr.	5.10	12.0	....	....	0	....

*The above well is situated near the Dye House, in the thickly settled part of the city, and the water is said to have been used extensively by the mill operatives, being popular on account of coldness and freedom from color, in contradistinction to the city supply, which is highly colored. While this is a fair illustration of the fact that the consumer invariably prefers and expects good appearance in his water supply and that it is folly for any town or company to suppose that the public will permanently accept a highly colored supply, yet in the case of this particular well water, the appearance is deceptive.

Springfield.

Examination of Water from Well of R. L. Heath, Used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11786	1913 Nov. 20	Consid. opal	Sl. fine	None	0.25	.0010	.0034	.0500	.0000	.05	3.6	....	....	0	....

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Stewartstown.—A few families in the village of West Stewartstown are furnished with water by the Consolidated Water Company from springs situated beyond the Canadian line.

Examination of Water from Springs Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12180	1914 June 1	None	None	None	0.03	.0006	.0014	.0200	.0000	.05	2.9	....	....	0	0

Stratford.—A gravity system from springs operated by the Coös and Essex Water Company furnishes water to North Stratford.

Examination of Water from Supply of Coös & Essex Water Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10944	1913 April 24	V. slight	Sl. silt	None	0.05	.0006	.0010	.0050	.0000	.05	1.7	0	....	0	....
12127	1914 May 15	None	Sl. fine	None	0.03	.0014	.0016	.0030	.0000	.06	1.8	....	....	0	0

Strafford.—*Examination of Water from Bow Lake.*

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10779	1913 Feb. 23	Sl. arom.	V. slight	Fishy	0.15	.0024	.0126	.0025	.0000	.11	0.1	....	....	0	....
10792	Mar. 2	Slight	V. slight	Sl. marsh	0.18	.0026	.0125	.0025	.0000	.11	0.1	....	....	0	....

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Stratham.

Examination of Water from Well Supplying School.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11331	1913 July 31	None	Mod. coarse floc.	Decid. arom.	0.25	.0010	.0030	.0100	.0000	.85	8.9	....	....	0	....

Sunapee.—The town system (Sunapee village) has its source in Lake Sunapee, the water being pumped to a reservoir of 300,000 gallons. George's Mills is supplied from Ledge Pond.

Examination of Water from Lake Sunapee.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10,963	1913 April 28	V. slight	Sl. fine	None	0.10	.0006	0064	.0050	.0000	.09	0.3	....	....	0	....
11,724	Oct. 30	V. faint	V. slight	V. slight	0.08	.0006	.0123	.0050	.0000	.09	0.6	....	....	0	....
12,108	1914 May 14	None	V. sl. fine	None	0.12	.0006	.0054	.0030	.0000	.08	0.6	....	....	0	0

Examination of Water from Ledge Pond.

11725	1913 Oct. 30	V. faint	V. slight	V. faint	0.08	.0008	.0134	.0050	.0000	.09	0.6	....	Tr.	0	....

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Sutton.

Examination of Water from Wells Supplying Schools.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10518	1912 Sept. 30	Slight	Mod. white	Mark earth	0 15	.0010	.0010	.0450	.0000	.20	1.9	....	....	+	...[1]
11565	1913 Sept. 9	None	V. slight	None	0.07	.0006	.0050	.0030	V.sl. trac.	.35	2.4	....	.. ..	0	...[1]
11662	Oct. 13	Consid. opal	Consid. earth	Decid. veg.	0 25	.0180	.0114	.0100	Dist trac.	.20	2.0	....	....	0	...[2]

[1] School at South Sutton. [2] School at North Sutton, new well.

Swanzey.

Examination of Water from Well of Swanzey School District.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,660	1913 Oct. 9	Mod. opal	Sl. fine	Sl. earth	0.07	.0010	.0014	.0200	.0000	.75	3.5	...	..	0	....

Examination of Water from Well Used at Shop of West Swanzey Box Company.

12306	1914 July 1	None	Slight coarse	None	0.05	.0014	.0054	.1000	.0000	.60	4.5	....	...	+	....
12542	Aug. 31	Slight	Slight	Faint earth	0.02	.0002	.0030	.2250	Tr.	.45	5.0	....	...	+	....

Examination of Water from Well of the Snow & Brindell Co.

10,458	1912 Sept. 4	None	V. slight	Sl. earth	0.00	.0005	.0010	.0050	.0000	.20	4.6	.010	....	+	....
10,680	Dec. 18	Mod. opal	None	V. sl. foul	0.05	.0010	.0010	.0025	.0000	.45	3.2	.010	....	0	....

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Examination of Water from Well of George E. Whitcomb, Used by Public.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,715	1913 Oct. 24	None	Sl. floc.	Sl. foul	0.05	.0008	.0070	.250	Tr.	1.30	9.0	....	....	+	....
12,212	1914 June 8	None	V. slight	None	0 00	.0006	.0034	.040	.0000	0.90	2.2	....	....	0	....

Tamworth.

Examination of Water from Well of H. L. Wiggin, Supplying Swift River House.

Number	Date of collection	Appearance			Color	Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor		Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,424	1913 Aug. 11	None	V. slight	None	0.05	.0006	.0040	.0300	.0000	.50	3.2	....	....	0	....

Examination of Water from Supplies owned by S. G. Davidson, Used by Camp.

11173	1913 June 22	Mod opal	V. slight	V. sl. foul	0.10	.0006	.0050	.0050	.0000	.10	2.0	....	....	0	...[1]
11174	June 22	None	None	None	0.05	.0003	.0010	.0100	.0000	.10	1.1	....	....	0	...[2]
11175	June 22	None	None	None	0.05	.0006	.0010	.0050	.0000	.05	0.3	....	....	0	...[3]
12284	1914 June 19	None	None	None	0.00	.0014	.0078	.0030	Hi'h	.18	2.0	...	....	0	...[3]
12285	June 19	V. sl. opal	None	None	0.00	.0010	.0010	.0030	Ft. tr.	.07	2 0	....	...	0	...[3]
12286	June 19	None	None	None	0.00	.0006	.0014	.0200	.0000	.08	0.4	....	....	0	...[2]

[1] Reservoir. [2] Spring. [3] Well

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Thornton.

Examination of Water from Spring of L. N. Brown, Supplying Mt. Kineo House.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,358	1913 Aug. 7	None	None	None	0.05	.0006	.0006	.0025	.0000	.03	0.1	.050	....	+	....

Tilton.—A gravity system operated by the Tilton & Northfield Aqueduct Company furnishes water to the villages of Tilton and Northfield from Chestnut Pond.

Examination of Water from a Faucet of the Tilton & Northfield Aqueduct Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,041	1913 May 21	Slight	Sl. fine	Sl. arom.	0.20	.0010	.0080	.0050	.0000	.05	0.3	....	....	0	....
11,776	Nov. 19	Sl. opal	V. slight	Sl. earth	0.12	.0008	.0084	.0050	.0000	.09	0.3	....	....	0	0
12,184	1914 June 2	V. slight	Slight floc	V. slight	0.15	.0010	.0079	.0030	.0000	.09	0.1	....	....	0	+

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Troy.

Examination of Sources Under Consideration for a Public Supply System (see Special Report elsewhere).

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,019	1913 May 15	Slight	Sl. floc.	V. slight	0.35	.0010	.0060	.0050	.0000	.10	0.1	....	....	0	...[1]
11,020	May 15	Slight	Mod. br. floc.	Sl. swamp	0.55	.0006	.0128	.0050	.0000	.05	0.1	....	....	0	...[2]
11,021	May 15	V. slight	Sl. floc.	Sl. swamp	0.40	.0010	.0070	.0050	.0000	.07	0.1	....	....	0	...[3]
11,022	May 15	V. slight	Sl. floc.	None	0.70	.0006	.0030	.0050	.0000	.05	0.1	....	....	0	...[4]
11,037	June 1	V. slight	Sl. floc.	Sl. marsh	1.30	.0010	.0110	.0025	.0000	.05	0.1	....	....	0	...[5]

[1] Whitcomb Brook. [2] Ratikan Brook. [3] Mitchell Brook
[4] Fassett Brook. [5] Dexter Brook

Examination of Water from Well of Troy School District.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11566	1913 Sept. 8	Slight	Very slight	None	0.10	.0010	.0010	.7090	Dst. tr.	.80	4.0	....	....	0	....

Wakefield.—A system owned by the railroad company furnishes water from the river for stores, town buildings and railroad station. The analyses here appended is indicative of a polluted condition.

Examination of Water from Railroad System.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11775	1913 Nov. 19	Slight	Slight floc.	Earthy	0.25	.0020	.0088	.0100	.0000	.40	1.7	....	....	+	+

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Examination of Water from Well of Wakefield Slipper Company.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11643	1915 Oct. 2	None	Consid. ferruginous	Slight	0.15	.0010	.0010	.050	Tr.	1.75	7.9	....	Consid.	+	....

Examination of Water from Well owned by Congregational Church.

11768	1913 Nov. 13	H. opal	Consid. earthy	Decid. veg.	0.40	.0050	.0194	.010	Tr.	0.45	3.9	....	....	+	....

Examination of Water from Well of A. D. Hill, Supplying The Colonial.

11,413	1913 Aug. 13	None	None	None	0.00	.0034	.0030	.3000	.0000	2.90	4.6	....	...	0	....

Examination of Water from Well of Philip Garvin, Used by Public.

12,445	1914 Aug. 5	None	V. sl. floc.	None	0.00	0010	.0030	1 0000	h'gh	7.40	5.9	....	....	0	....

Examination of Water from Well of George Hodsdon, Used by Public.

12,499	1914 Aug. 19	V. slight	V. slight	Dist. veg.	0.05	.0010	.0010	.0060	.0000	.55	1.9	....	....	0	....

Walpole.—The Walpole Water and Sewer Company operates a gravity system from an impounded stream.

The North Walpole supply is derived from springs.

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Examination of Walpole Water Supply.

Number	Date of Collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Alkalinity	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c.c.	10 c.c.
11050	1913 May 21	None	None	None	0.05	.0010	.0020	.0050	.0000	.12	2.3	....	....	0	....
12296	1914 June 27	None	None	None	0.10	.0006	.0044	.0030	.0000	.08	2.5	....	....	0	0

Examination of Water from Supply of North Walpole.

11028	1913 May 20	Ft. opal	None	None	0.05	.0006	.0040	.0050	.0000	.15	2.0	.010	....	0	....
12268	1914 June 25	None	None	None	0.00	.0008	.0020	.0030	.0000	.18	1.5	.015	....	0	+

Warner.—The village fire district system is from springs and a brook. A recently drilled well is in reserve for emergency use.

Examination of Water from a Faucet of the Village District Supply.

Number	Date of Collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11130	1913 June 11	Slight	Mod. sl. floc.	Slight	0.20	.0010	.0044	.0050	.0000	.04	0 1	....	....	0	....
11179	June 24	V. slight	V. slight	Sl. foul	0 05	0010	.0010	.0050	.0000	.12	2.7	....	Slight	0	...[1]
12344	1914 July 9	V. slight	Slight	Sl. earth	0.22	.0006	.0062	.0030	.0000	.04	0.4	....	....	+	+
12452	July 10	.....	.....	.....	....	.....	... .	....	.....	...	....	....	....	0	0

[1] New artisian well.

Warren.—The H. N. Merrill Water Works furnishes water from springs and from a drilled well 474 feet deep.

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Examination of Water from Brook Used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11778	1913 Nov. 18	None	None	None	0.15	.0010	.0034	.0200	.0000	.08	0.7	....	....	0	0

Weare.

Examination of Water from Well owned by Baptist Society.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12305	1914 July 1	Sl. opal	V. sl. floc.	V. slight	0.05	.0020	.0014	.0050	.0000	.90	1.9	.015	...	0	....

Webster.

Examination of Water from Well of S. Godfrey, Supplying Cloverdale Farm.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11304	1913 July 25	None	V. slight	Sl. veg.	0.05	.0040	.0060	.2500	High	.95	3.2	....	....	+	....

Examination of Water from Spring of F. V. Thompson, Supplying Breezy Hill Farm.

11306	1913 July 25	Heavy opal	V. Slight	Sl. earth	0.10	.0006	.0010	.0025	.0000	.08	2.0	.020	....	+	....

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Wentworth.

Examination of Water from Spring of Virgil Prettyman, Used by School Camp.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12242	1914 June 6	None	Sl. coarse	None	0.00	.0008	.0018	.0030	.0000	.20	2.4	....	....	+	....

Whitefield.—The town system has its source in a mountain brook.

Examination of Water from Town Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11056	1913 May 27	Slight	Mod, fine	Sl. veg.	0.07	.0006	.0080	.0025	.0000	.05	0.3	....	....	0	....
12178	1914 June 2	None	Sl. gray floc.	None	0.10	.0026	.0044	.0070	.0000	.07	0 2	....	....	0	0

Wilton.—Source of town system, Gaerwin Falls Brook, with storage and reserve in Burton Pond. (See special report elsewhere.)

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Examination of Water from Wilton Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10820	1913 Mar. 18	V. slight	None	Sl. swamp	0.25	.0010	.0065	.0025	.0000	.15	0.3	.050	....	0	....
10850	April 2	V. slight	None	Earth	0.35	.0010	.0084	.0050	.0000	.16	0.1	.030	....	0	....
10931	April 21	V. slight	None	Earth	0.35	.0010	.0050	.0050	.0000	.15	0.1	....	....	0	....
11257	July 17	None	V. slight	Ft. earth	0.08	.0006	.0016	.0050	.0000	.15	0.3	....	....	0	+[1]
11258	July 17	Consid. fine veg.	Sl. gelat.	Dist. swamp	0.45	.0006	.0200	.0050	.0000	.15	0.3	....	....	0	+[2]
11318	July 29	Mod. fine	Mod. fine veg.	Mark. arom.	0.60	.0010	.0190	.0050	.0000	.14	0.3	....	....	+	...[3]
11319	July 29	Mod.	Mod. fine veg.	Sl. arom.	0.55	.0010	.0180	.0050	.0000	.14	0.1	....	....	+	...[3]
11490	Aug. 26	V. slight	None	Decid. veg.	0.35	.0010	.0090	.0050	.0000	.12	0.3	....	....	0	....
12183	1914 June 4	None	None	Sl. swamp	0.35	.0010	.0068	.0030	.0000	.11	0.3	....	....	0	+

[1] Stockwell Brook. [2] Burton Pond.
[3] From reservoir, mainly Burton Pond water.

Examination of Water from Well of Wilton School District.

12079	1914 May 4	None	None	Ft. sweet	0.00	.0008	.0016	.3500	.0000	.40	3.2	.040	....	0	....

Examination of Water from Well of Jennie M. Hobbs, Used by Public.

10,491	1912 Sept. 13	None	None	Sl. veg.	0.05	.0030	.0064	.2500	h'gh	4.76	6.6	..	....	+	....

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Examination of Water from Well of D. Whiting & Sons, Used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
10762	1913 Feb. 18	None	None	None	0.00	.0010	.0020	0750	.0000	1.10	4.6	.050	....	0	....

Winchester.

Examination of Water from Well of C. E. Hildreth, Used by Public.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
12467	1914 Aug. 12	None	None	None	0.00	.0004	.0010	.0100	.0000	.10	1.1	....	....	0	....

Windham.

Examination of Water from Well of Mrs. J. A. Leavitt, Supplying Elm Knoll.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11,308	1913 July 28	None	V. slight	None	0.05	0006	.0016	0.00	.0000	.45	7.4	.. .	....	+	....

Examination of Water from Well of Mrs. H. W. Gilson, Supplying Echo Farm.

11309	1913 July 28	Mod. opal	Mod. floc.	Dist. foul	0.35	.0100	.0050	.0100	.0000	.80	8.1	..	...	0	....

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Examination of Water from Well of Frank Jewett, Supplying Jewett Farm.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11311	1913 July 28	None	V. slight	Sl. earth	0.00	.0010	.0916	.2500	High	.55	4.7	....	....	0	....

Examination of Water from Well of Mrs. G. H. Peters, Supplying The Brookside.

11312	1913 July 28	None	None	None	0.05	.0006	.0010	.0100	.0000	.12	1.6	....	....	+	....

Examination of Water from Well of G. E. Jackson, Supplying Elm Farm.

11313	1913 July 28	V. slight	V. slight	None	0.10	.0010	.0120	.3000	.0000	3.15	6 0	....	....	0	....

Wolfeboro.—The town system (gravity) has its source in a pond of three hundred acres.

Examination of Water from Public Supply.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11 083	1913 June	Sl. opal	Sl. white	Sl. veg.	0.07	.0010	.0090	.0050	.0000	.11	0.3	....	....	0	....
12,294	1914 June 6	V. slight	Sl. fine	Earthy	0.07	.0010	.0104	.0030	.0000	.11	0.4	....	....	0	0

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*Examination of Water from Well owned by Boston & Maine Railroad.**

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11767	1913 Nov. 13	None	None	None	0.03	0010	0018	.3000	.0000	2.95	4.6	....	....	0	....

* The train supply is taken from the town system.

North Woodstock.—A system owned by the village of North Woodstock has its source in a brook.

Examination of Water Supply of North Woodstock.

Number	Date of collection	Appearance				Ammonia		Nitrogen as		Chlorine	Hardness	Lead	Iron	Colon Bacilli	
		Turbidity	Sediment	Odor	Color	Free	Albuminoid	Nitrates	Nitrites					1 c. c.	10 c. c.
11025	1913 May 21	V. slight	None	None	0.45	.0010	.0080	.0100	.0000	.05	0.1	....	....	0	....
11473	Aug. 22	Slight	V. slight	None	0.45	.0010	.0030	0025	.0000	.05	0.1	....	....	0	....
12236	1914 April 18	None	None	None	0 35	.0008	.0069	.0030	Trace	.07	0 1	....	..	0	0

Examination of Ice Supplying Boston & Maine Railroad.

12253	1914 June 18	V. slight	Sl. fibre	None	0.00	.0006	.0012	.0030	.0000	.01	0.0	....	....	0	....

Examination of Water from Well Owned by Bell Estate, Supplying Deer Park Hotel.

11519	1913 Aug. 28	Sl. fine	Mod. earth	Mark arom.	0.18	.0026	.0030	.010	Trace	.23	1.7	....	....	0	....

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Reports and Recommendations Relating to Various Water Supplies as Submitted by the Chemist of the Board.

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SPECIAL REPORTS RELATING TO WATER SUPPLIES.

HUDSON.

The following opinion as to the character of the well water supply of the Hudson Water Company was furnished to the Public Service Commission in connection with a petition from the Hudson consumers. (See page 151, Rep. 1911–12.)

Public Service Commission, APRIL 23, 1913.
State House, Concord, N. H.

GENTLEMEN:—Concerning the present quality of the well water supply of the Hudson Water Company, I am enclosing sheet giving analytical data, tabulated to allow of comparison, and would offer the following comments:

Samples were collected March 27 by a representaive of this department from all three of the sources involved. As, previous to this collection there had been much heavy rain, another set of samples was taken on April 8. The examinations, however, indicate no very marked differences between the two collections. In fact, the composition of the water from all three sources is practically the same.

In general it may be stated that the analyses all indicate water of satisfactory quality. Those of March 27 represent water quite above criticism in every way, with the sole exception that both of the large well samples deposit a slight but distinct stain consisting of iron in combination with traces of organic matter. In the later samples, this stain is not present at all, and the organic matter is evident in the slightly increased values for albuminoid ammonia.

While it is therefore quite probable that in time this water—at least from the large wells will deposit an iron stain on fixtures with which it comes in contact, this would seem to be about the only serious criticism that can be urged against the supply, as otherwise, so far as our analyses indicate, it compares not unfavorably as to quality with that of the Pennichuck supply.

As regards the actual quantity of iron present, the figures given represent but a trace, the amounts being within the limits ordinarily recognized in connection with potable waters. Yet, small as it is, it is not difficult to appreciate that such iron content might be a source of annoyance in some instances, though probably not in any general way. While the driven well water seems to carry no iron at present, our experience is that this mineral is liable to appear in time.

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Hudson Water Works.

Analyses of Samples from Wells.

(a)

Examination of samples collected March 27, 1913, by Mr. W. L. Adams, from wells (1) and (2) and new driven well supply. Samples taken following 36 hours heavy rain.

	Well No. 1	Well No. 2	Driven Wells
	10836	10835	10837
Odor	none	none	none
Color	.05	.07	.07
Turbidity	.10	.10	.10
Sediment	v. sl.	v. sl.	v. sl.
Free ammonia	.0010	.0014	.0006
Albuminoid ammonia	.0010	.0010	.0010
Nitrates	.005	.005	.003
Nitrites	.0000	.0000	.0000
Chlorine	.34	.28	.32
Solids	5.3	4.3	4.5
Hardness	1.4	0.9	1.4
Colon bacilli	absent	absent	absent

(b)

Samples collected by the superintendent, April 8, 1913:

	10872	10873	10874
Odor	sl. earthy	sl. earthy	dist. earthy
Color	.05	.05	.05
Turbidity	.10	.10	.25
Sediment	v. s. gray flocc.	sl. gray flocc.	v. slight gray flocc.
Free ammonia	.0010	.0010	.0010
Albuminoid ammonia	.0036	.0040	.0030
Nitrates	.005	.005	.005
Nitrites	.0000	.0000	.0000
Chlorine	.27	.35	.36
Solids	.....	.....	.....
Hardness	1.5	1.4	1.8
Iron	0.015	0.025	0.00
Colon bacilli	absent	absent	absent

In table (a), samples 10836 and 10835 deposit a slight film or stain of *iron* on the bottom of the bottle, on sanding a day or two; this did not occur with the two corresponding samples of April 8. The driven well water seems to be virtually free from iron.

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DERRY.

An examination made June 17, 1913, of the Derry water supply system revealed the following facts:

It appears that until about six years ago this supply was derived mainly from a series of about thirty driven wells, sunken in low ground near the confluence of Horn and Beaver Brooks, southwest of Derry Depot. At this time there was, however, so it is said, frequent resort to direct pumpage from Beaver Brook, which is a stream flowing from Beaver Pond and skirting the eastern edge of the principal village. The latter source being sewage-polluted, and the driven wells becoming clogged and failing to furnish an adequate supply, the latter were eventually entirely abandoned and a supply secured through the construction on the same site of five large dug wells. In addition, an emergency intake is retained in Beaver Brook in the rear of the pumping station, from which stream condensing water for operation of the pumps is also secured. It was represented that this emergency intake has not been opened since 1909, during the occasion of a fire. At this time, it is said, numerous cases of bowel disturbance arose among the water users, as might be anticipated, in view of the pollution to which this stream is subject.

Two of the present wells are located on the west side of the roadway, across from the pumping station. No. 1, the larger, is 25 feet in diameter and 14 feet deep, No. 2 being 14 feet in diameter and 11 feet deep. The latter is less than 100 feet from the brook. The three wells on the other (east) side of the street are of square construction, the dimensions being: No. 3, 16 feet square, No. 4, 14 feet square, and No. 5, 6 feet square, all being approximately 11 feet deep. No. 4 is but 80 feet, approximately, from the brook. All of these wells are tightly covered, and are so cemented and provided with raised curbs as to exclude any direct influx of surface water.

At this point, opportunity may be taken to express criticism of the general plan of this system. This is based upon the fact that the town is doing no less than both drawing its water supply and disposing of its sewage in the same locality—practically in the same spot. While Derry is at present at a considerable disadvantage in that it has no regular system of sewerage, yet the sewage from a number of factories and tenements, as well as that from the buildings along a portion of the main street, is conducted in a sewer to the banks of Horn Brook at a point some distance above the pumping station, thence along the west bank to a point about 700 feet below the nearest well, where it is discharged into the brook. At times, it is said, the height of the water in the brook is such as to cover the pipe, and as leaks have occurred in the latter, more or less sewage from this source is liable at times to find its way into the brook.

This, however, is possibly the least of the contamination which this brook receives, and it should be noted that the stream above its union with Beaver Brook is but a small one, incapable of properly caring for any extensive influx of sewage. For half a mile or more above such junc-

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tion at the pumping station the flow of Horn Brook is through the most thickly settled portion of the town, and receives the drainage from numerous dry closets, cesspools and sink-drains, as well as the wash from littered back yards, pigpens, etc. At one point, a stream of wash-water from a laundry was observed pouring directly into the brook.

However, this also is but a smaller part of the contamination to which this brook is subjected. At a point about a half mile above the pumping station a voluminous discharge of leather-board waste was found entering the brook from the factory of the Walton Shoe Company. At this place a large pile of such waste was observed standing partly in the brook, although the latter at this place is but a few inches deep and probably between two and three yards wide only.

The result is that Horn Brook, by the time it discharges into Beaver Brook at the pumping station, is but little better than an open sewer. Its appearance is that of a black hog-wallow, while the sewage stench, faintly though distinctly noticeable at the time, is said to be very pronounced in dry weather, when the brook is lower than at present. At such times the odor is materially augmented by that from the sewage discharged in the main brook just below the wells.

Aesthetic considerations would condemn such an intermingling of sewage odors with the sources of water supply. Granted, however, that such odors cannot of themselves actually injure the quality of the water, yet that the close proximity of sewage to the wells leaves its mark upon the character of the water is evident from the series of analyses of this supply, representing samples collected since January, 1906, down to the present time. (See various reports of this Board.)

The factor most significant of the influence of the nearby sewage upon the character of this water is the chlorine content. This, as will be observed, not only fluctuates through a wide range—much wider than is true of any of our normal public supplies—but the actual amount is materially above the normal for pure water for this locality (0.18). Thus in March, last, the chlorine reached the highest point thus far observed (1.40), notwithstanding that during the period represented it has been as low as .25. In general, the chlorine data seem to denote a progressive tendency upward. Another figure that is eloquent of the pollutive influences to which this water is subjected is the nitrate content. Although not much above normal of late, the amount has in times past greatly exceeded such, the highest observed figure being 0.350, or at least seventy times as much as the majority of our public supplies will show. The water representing these relatively highly nitrated samples could scarcely have been taken direct from the brook, as the nitrogen content of the latter would be chiefly of a lower form of oxidation.

The loose, gravelly soil, however, in which these wells are constructed affords excellent means for self purification of the seepage water from the brook, through the influence of the nitrifying organisms naturally present. That such soil is acting as a sewage filter, not only in some degree all the time, but at certain periods in a very extensive way, is apparent not only from the above analyses but from the allegation that the plot on which

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these wells are located is inundated from the brook nearly every year—a statement that finds ample corroboration in the numerous bits of leather-board scrap to be found in the grass about the wells. This water is clear, tasteless and most of the time of good appearance, and no doubt the people of Derry may believe they have a superior supply. Physically considered, this is true; yet there is no escaping the fact that there is an element of danger attached to it. The security of the community from a water-born epidemic is measured directly by the capacity of this natural filter to continue its present efficient service. On account of the more or less intermittent character of its action, this may continue for years; yet the fact must not be lost sight of that no filter can be depended upon to render effective service indefinitely, without proper renewal or attention. Sooner or later the time is liable to come when polluted water will reach the wells, and if this combination of circumstances should include that of typhoid dejecta in the sewage at the time in question, then an epidemic would obviously result, as it did recently in the cases of Somersworth and Durham during a similar combination of circumstances.

In this connection, as showing the progressive nature of the pollution of Horn Brook, the following analyses of samples collected June 18 are of interest: No. 1 is from Horn Brook, taken near the roadway just above the upper pond. At this point the brook doubtless receives a little wash from farm land, though this would not be true a little further above. No. 2 was taken from dam at the Walton Shoe Shop; No. 3, from a point just below the lumber mill and a short distance above the union with Beaver Brook. No. 4 was collected from Beaver Brook at the emergency intake in the rear of the station.

	No. 1.	No. 2.	No. 3.	No. 4.
Odor	ft. earthy	decided	marked foul	aromatic
Color	0.08	1.40	2.00	0.45
Turbidity	v. slight	v. slight	heavy	slight
Sediment	sl. flocc.	sl. gelat.	h. gelat.	sl. flocc.
Free ammonia	0.0010	0.0020	0.0024	0.0026
Albuminoid ammonia	0.0034	0.0290	0.0410	0.0190
Nitrates	0.010	0.010	0.015	0.010
Nitrites	0.000	0.000	0.000	0.000
Chlorine	0.27	0.27	0.65	0.25
Hardness	1.2	0.7	1.9	1.1
Colon bacilli (1cc.)	faintly positive	positive	str. positive	positive

The features of interest in connection with the above data are color, sediment, odor, albuminoid ammonia and chlorine; also the colon finding. No. 3 is similar in some respects to a weak sewage; in fact, the decomposing leather-board waste causes it to look much worse than the average sewage. Although No. 2 was collected at the dam, a few feet above the present point where leather-board waste is discharged, the color and organic content is very high, and would suggest that considerable waste is also being discharged in the pond, as well. Aside from a faint reaction for colon

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bacilli, No. 1 represents good water, and it is probable that by going a little farther up the brook, water of excellent character might be secured. It was a mistake not to have located the pumping station here rather than where it is.

Horn Brook is not only a constant and increasing menace to the present water supply of Derry, but, in my opinion, it constitutes in its present condition a decided public nuisance. We are informed that previous attempts to have this brook cleaned up have failed, for certain reasons. However, any attempt of this sort should not stop at exclusion, merely of the manufacturing sewage. Not only should the leather-board waste be denied discharge in this brook (such waste might easily be dried and burned), but the entrance of sewage of any sort should be forbidden, as should also be forbidden the dumping of refuse of any description whatever in or along its banks, within the compact part of the village.

JULY 1, 1913.

DOVER.

Question having arisen as to the propriety of the establishment of a cemetery in the vicinity of Willand Pond, one of the sources of water supply for the city of Dover, an examination was made July 25, 1913, of the situation by the chemist of the Board, who reported as follows:

The tract in question is located west of the pond, the distance from the nearest water edge to the fronting highway fence being stated as 1,225 feet. As it is claimed that a depth of 200 feet from the highway is to be reserved for building purposes, this would therefore make the distance from the pond to the nearest line of graves 1,425 feet. The total highway frontage is approximately 1,200 feet. The soil consists of sand underlayed by gravel. The rear half of the tract slopes in the opposite direction, and there are no "runs" leading from this vicinity to the pond. The land intervening between the plot and the pond slopes very gradually toward the latter, in fact, presenting to the eye a practically level appearance. Such intervening land is traversed by two highways.

While from the testimony adduced there can be little doubt that the general trend of the ground water current is toward the pond, yet I am of the opinion, from a consideration of all the facts, that any danger of contamination of the pond supply from such a source is so extremely remote as to be negligible. In fact, it might be pointed out that far more dangerous sources of possible contamination already exist much nearer the pond.

SOMERSWORTH.

The following report and recommendations are submitted relative to an inspection made December 9, 1912, of the plant of the Somersworth Water Works. The latter includes a pumping station and filtration plant located two miles northeast of the city. The water is taken from the

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Salmon Falls River, is passed through a filter bed, and is pumped thence to a covered, steel standpipe:

The filter, which was among the first to be constructed in this country, and the second one in this country of the covered type, was completed in 1897, following the selection of this river supply as a result of the failure of a driven well project. Except for the cover, its design follows closely that of the original construction of the famous Lawrence, Mass., filter—the first high efficiency plant in America, installed in 1893.

In order that the subsequent criticisms and recommendations may be more clearly understood, a brief description of the Somersworth plant is here given.

Like the original form of its prototype, this plant still includes but a single filter bed. As was soon discovered at Lawrence, and there early rectified, this arrangement is not only highly inconvenient as regards cleaning, etc., but renders the maintenance, at all times, of a properly purified water supply a very difficult, if not an impossible, matter.

The intake of the system is 18 feet off shore, at a depth of six feet below mean water level. The water flows by gravity, through a 16-inch iron intake pipe, to the "screen" or settling well 34 feet from shore. This well is eight feet in diameter, and is divided by a double screen septum, for the separation of any coarse materials. On December 9, this well contained eight feet of water. Leading from the screen well are two gate-controlled 16-inch pipes, one of which, for emergency use, runs direct to the pump well in the station; the other serves to convey water to the filter bed. Before entering the filter, the latter pipe splits into a Y of two 12-inch branches. These terminals enter "pockets" built into the filter wall on the sand level, each 12 feet long, by 25 inches high, by 12 inches deep, and provided with flash boards, thus permitting the water's reaching the bed in two very broad, shallow streams, and thereby avoiding disturbance of the sand stratum.

The filter bed is rectangular, 148 feet x 150 feet, equivalent to an area (after deducting for area of roof-supporting piers) of exactly one half acre. The floor is on natural gravel and ledge, 8½ feet below mean river level. The walls are of concrete masonry, and are quite vertical, without the "breaks," or projecting ledges, now considered desirable for the avoidance of direct passage of the water between the walls and the sand stratum.

The roof is supported on groined arches of brick and concrete, the earth covering, amounting to 2½ feet at center, sloping slightly at sides to facilitate drainage. The interior is reached through a series of double covered manholes.

The collection drains, sunken in the floor of the filter, consist of a single main traversing the center in a southwesterly direction, and a series of laterals. The main terminates in the 16-inch pipe that carries the water from the filter bed to the regulating well, or chamber.

The total depth of the filter bed, as originally constructed, was five feet, including one foot of assorted gravel underlying four feet of sand. Tests made with an iron bar at the time of my visit indicated a very nearly normal depth of sand. The "effective size" of sand used is reported as

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ranging from .30 to .45 millimeter. Analysis of a sample of the washed sand, taken December 9, showed an effective size of 0.33 millimeters, with a uniformity coefficient of 2.97. The latter is a very wide ratio, and serves to explain, in a measure, the long working capacity of this filter. The size of grain, however, while somewhat larger than that at Lawrence, is about that commonly used elsewhere. At intervals, the dirt surface film of the bed is scraped up into piles, whence it is conveyed by an ejector to the surface, and, later (during the summer) is passed through a sand washer, this cleansed sand being returned to the bed once each year.

The regulating chamber referred to, located at the lower extremity of the filter nearest the pumping station, consists of a covered well divided into two sections, one section receiving the water from the filter, the efflux of which is controlled by a gate and special mechanism. This section is also provided with a centrifugal pump, connected with a 10-inch waste pipe leading back to the river, the object of the latter being to permit of the draining of the filter bed for cleaning, etc.

The second section communicates both with the first, and with the direct main from the screen well, and from this section the filtered water flows by gravity to the pump well in the station, from which it is pumped to the standpipe. The latter is 95½ feet high and 40 feet in diameter, with a capacity of 902,147 gallons.

The level of the water upon the filter is dependent upon the level of the water in the river, varying from 4 to 6 feet. This allows of a rather unusual "head," the depth at Lawrence generally not much exceeding 3½ feet.

The present daily pumpage is given as 500,000 to 600,000 gallons, a filtration rate per acre of somewhat over 1,000,000 gallons. This is a low rate, as with care and favorable conditions, over 3,000,000 gallons can be safely filtered in a plant of this type. This low rate, combined with the "head" available, doubtless also serves to explain why it has been possible to prolong the cleaning periods so much beyond the normal. On the other hand, as offsetting the advantage of low rate and great attainable head, there has been much complaint of the sludge discharged into the river from the leatherboard factories above. It is represented that in the past this sludge, consisting of iron oxide, lampblack, and vegetable fibre, has collected in great quantities upon the filter surface, where it formed an almost impenetrable layer.

At present, following the installation of the sludge tanks, it is certain that there is very much less sediment coming down the river than formerly, although the superintendent claims that this is still causing considerable trouble at times; but on the date in question the appearance of the river gave no special evidence of foulness, neither did the surface film on the filter, which latter represented a discoloration of the sand through about a half inch, resulting from an accumulation period of about forty days,—the filter having been last scraped and the washed sand replaced on October 30.

The previous cleaning was done in April, involving the very unusual interval of six months, as against the average interval elsewhere of about

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one month. In cleaning, the customary removal is one-half inch to three-fourths inch of sand. Here, the removal is stated as being not less than two inches, and running up to as much as four or five inches in places.

In considering this matter of surface accumulation, it needs to be distinctly understood that a certain thickness of "dirt" film is absolutely essential to a proper degree of efficiency. It is a well-known fact that for the first day following cleaning, the bacteriological efficiency is very low indeed, and for a few hours, at least, little or no safety is afforded. On the other hand, there is room for some question if it is entirely safe or well to allow the accumulation to continue through such a long interval as above, involving, as it does, the removal and attending disturbance of several inches of sand at one time.

However, in this case, as with the cleaning of the filter, it is necessary to emphasize the distinct advantage that the Lawrence plant now possesses over the one in question. While the former now has four independent beds, the low efficiency temporarily resulting from the cleaning of one of these is compensated for in the fact that the output is diluted by that of the other three—whereas, in the Somersworth case, such low efficiency affects *all* water pumped to the standpipe during the interval in question.

Again, there is a further dilution in the first case, in that Lawrence has a storage capacity of ten times its daily pumpage; while that of Somersworth is less than double.

For the above reason, when the filter is cleaned it is necessary to hurry the work through in less than twenty-four hours, always with the risk of a serious fire at this juncture necessitating the opening of the direct gate from the river to the pump well. Then, too, when water is finally applied to the newly cleaned filter, the period either of quiescence or of very low initial "head," customary at this point, cannot be maintained as long as is desirable, with the limited storage capacity.

The remedy is in the construction of a partition wall so as to divide the present bed into two. This would allow of one filter being in operation, affording sufficient water for the normal demand, while ample time would be allowed to clean the second bed—not only as thoroughly, but as frequently as desirable. In this way the danger of infecting the supply with sewage-polluted, incompletely filtered river water would be greatly reduced. At present, the chance of such infection, following the filter cleaning, is very considerable.

The construction of such a filter wall presents two problems. The first involves mainly the difficulty and expense attendant upon the relocation and construction of an additional trunk line drain in the floor of the filter. The second has to do with ways and means of getting pure water during the interval while the filter bed would be out of commission. At Lawrence, this problem was not involved, because of the ample reserve.

The solution I would suggest for the latter would be in the installation of an equipment for applying the hypochlorite treatment. In this way water could if necessary be introduced directly from the river, and the treatment at this point would render it safe, although the mechanical straining out of the excess of sediment would, of course, be wanting—a minor

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consideration for temporary purposes. Such a sterilization plant, being inexpensive, might well be made permanent, for emergencies. For treatment of the water following the filter cleaning, it might also be considered as an alternative to the subdivision of the filter, although the latter would probably be preferable in the end, while the former would not solve the problem of more ample time for cleaning.

Another improvement which is to be recommended is an increase in the size of the screen well. This is but eight feet in diameter, and, as the superintendent states, the water much of the time flows through immediately, allowing scarcely any interval for subsidence. Yet, even as it is, this well has to be cleaned frequently. When the plant was constructed, this was not a serious matter. The installation of a sedimentation basin several times the size of the well would prove of very great advantage. While this recommendation may not seem to be wholly consistent with the present long interval between cleanings, still I am convinced that such an enlargement would greatly facilitate the proper working of the filter. An enlarged area here would not only allow the removal of much of the suspended matter which must now necessarily go on to the bed, but the preliminary bacterial purification, through sedimentation, would be appreciable.

In connection with the construction of the latter, the color feature of this supply should be considered. This river water is normally quite highly colored. The ordinary filtration process removes but little of such color, and the residual color is greater than any community should be contented to remain permanently satisfied with.

So long as the city is going to the expense of subjecting its water supply to purification at all, it should go all the way while it is about it. The chemical treatment of raw river water at a properly enlarged and constructed sedimentation basin would not involve an unwarrantable expense in addition to the present cost of filtration, and such treatment could be made to produce a water of crystal whiteness.

This report includes rather frequent comparison of the plant in question with that of Lawrence. Incidentally, the city of Somersworth is to be congratulated upon the fact that the designer of this plant was able to profit by the Lawrence experience. The latter city has to sustain a very heavy annual expense in connection with the removal of ice from the original uncovered filters—an experience which Somersworth has wholly avoided.

Following is a summarized statement, with recommendations:

1. Because of the sewage-polluted condition of Salmon Falls River, involving the chance of frequent presence of typhoid bacilli, it is indispensable that there be no disturbance of the efficiency of filtration.

2. Under present conditions, immediately following the cleaning or renewing of the filters, there is, necessarily, serious disturbance of efficiency, extending from a few hours up to possibly a number of days.

3. To correct this at present unavoidable circumstance, the present filter bed should be subdivided, and the divisions then cleaned somewhat more frequently than at present.

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4. In order to effect this subdivision, the installation of an equipment at the pump well, for the application of the hypochlorite treatment, will be required. I would urge the extreme desirability of such being installed any way and at once for the purpose of rendering safe the effluent following the next filter cleaning.

5. The present screen well ought to be enlarged to a number of times its present size, in order to allow preliminary purification and the elimination of suspended matter.

6. At the time such an enlargement is effected, consideration should be given to the intallation of a coagulating equipment, affording means for the removal of color.

7. So far as can be found, the filter plant is being conducted in a capable manner. What is needed for a greater degree of efficiency is the improvement suggested. And, in turn, this should not be construed as reflecting upon the designer of the plant, for the reason that at the time of installation filtration processes were not perfected to their present degree.

8. Under normal conditions of filtration, the system should furnish a supply that is safe and suitable for drinking purposes,—aside from the single feature of the color present, which is an unattractive although harmless characteristic. The adoption of the improvements suggested should insure a supply that would be entirely safe and dependable at all times.

Respectfully submitted,

CHAS. D. HOWARD,
Chemist.

DECEMBER 14, 1912.

Subsequent tests have indicated a very low degree of efficiency for the filter alone. Unquestionably, the construction of the dividing wall and more frequent cleanings, as recommended in the above report, are essential for any really satisfactory operation. At this date, however, neither recommendation has been adopted.

CHLORINE TREATMENT AT SOMERSWORTH.*

In view of the deficiency already referred to, a process of treatment of the filtered water involving the use of liquified chlorine gas was however placed in operation March 15 of this year. The results afforded by this process, the second of its kind ever installed for regular use, have been satisfactory. Although almost untried at the time of its installation (and, in fact, certain minor improvements and changes have since been effected), yet that it affords a thoroughly practical method of disinfection is believed to have been demonstrated. Furthermore, the process offers certain advantages over the hypochlorine treatment, the only serious disadvantage over the latter being the present greater cost, and, as will be seen, this is more

*A similar system has recently been adopted for treatment of the Woodsville supply.

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apparent than real. It is believed that ultimately this method will very largely, if not entirely, supplant the use of bleaching powder for the purpose of water purification.

The installation is compact and simple, consisting of the cylinder of liquefied gas, from which the chlorine is delivered through a pressure-regulating and feeding device to an absorption tower, the aqueous solution here formed being thence discharged into the pump well.

The regulating and feeding device is obviously the vital part of the equipment, the perfection of which has involved a great deal of experimentation. After passing the right hand gauge (see cut), which registers cylinder pressure, the gas encounters a regulating device, or "transformer," which serves to reduce this pressure to a predetermined maximum. This, in conjunction with a second regulating valve, ensures the delivery of a constant uniform flow of gas irrespective of fluctuations in temperature and pressure at the cylinder, and such flow can be regulated and registered on the chlorine gauge for any desired weight delivery per hour. Since the installation, the company has made certain alterations in this part of the apparatus, and it is now claimed that the discharge as set on the gauge can be depended upon as being constant and accurate within reasonable limits. Unfortunately, the equipment as originally installed made no provision to allow of drawing off analytical samples of the gas solution as delivered into the well. However, a satisfactory check upon the indicated deliveries is afforded by the total weights of gas consumed. An additional check might be secured by balancing the gas cylinder upon scales.

Brass tubing, with lead-packed connections, is employed for conducting the gas to the absorption tower. The later consists of a section of soil pipe filled with broken pumice stone and through which from the top a small stream of water is allowed to descend. Dry chlorine gas has no action upon brass, but in the presence of moisture it is highly destructive, hence there are elaborate precautions to prevent any back current of moisture toward the cylinder. For conveying the gas solution to the well, hard rubber pipe encased in iron pipe is used.

The following data show the actual and indicated rates of consumption and treatment during the past six months, together with the cost of such based upon the charge of ten cents per pound for the gas.

COMPARISON OF ACTUAL AND INDICATED RATES OF CHLORINE CONSUMPTION AT SOMERSWORTH.

(1) Treatment commenced March 15, 1913. After a few days run it was discovered that the cylinder was delivering no gas and on the assumption that such was empty it was returned and found to contain a residual weight of 88 pounds of chlorine. Deterioration of the rubber washers originally used was found to be responsible for clogging of the cylinder orifice. Substitution of lead washers served to eliminate this difficulty.

(2) Second cylinder connected March 31, used until June 26; period of run, 87 days; weight of gas in cylinder, 110 lbs.

Average daily consumption (actual), 1.26 lbs.

Average hourly consumption (actual), 3.6 ounces.

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Indicated hourly consumption (chlorine gauge), 5 ounces.
Indicated daily consumption (chlorine gauge), 1.72 lbs.
Indicated consumption during run, 150 lbs.
Actual consumption during run, 110 lbs.
Actual daily cost of treatment, 12.6 cents.
*Actual rate of treatment (440,000 gallons daily), 0.34 parts chlorine per million.
Cost of treatment per million gallons, 28.6 cents.

(3) Third cylinder connected June 26, used until August 28; period of run, 63 days; weight of gas in cylinder, 98 lbs.
Average daily consumption (actual), 1.55 lbs.
Average hourly consumption (actual), 4.2 ounces.
Indicated hourly cconsumption (chlorine gauge), 5 ounces.
Indicated daily consumption (chlorine gauge), 1.88 lbs.
Indicated consumption during run, 118 lbs.
Actual consumption during run, 98 lbs.
Actual average rate of treatment (480,000 gallons average daily), 0.39 parts chlorine per million.
Actual daily cost of treatment, 15.5 cents.
Cost of treatment per million gallons, 32.3 cents.

WATER STERILIZING OUTFIT, SHOWING CHLORINE REGULATING APPARATUS.

Referring to the cut preceding, the gas is stored in the cylinder on the right, the pressure of which is indicated by the middle gauge. The gauge at the left indicates the rate of admission of the gas in ounces per hour, this being set at a definite point by means of the control valve shown at the left in the box. The absorption tower, from the bottom of which a hard rubber pipe conveys the gas solution to the pump well, is seen on the left.

In every case the treated water afforded negative results for colon bacilli, although with one or two exceptions such were uniformly present in one cubic centimeter of the raw water and were also found during the past year in a number of samples of filtered water.

The samples were collected and forwarded by the water works superintendent. Although kept on ice, it should be noted that as a rule there was an interval of about twenty-four hours between collection and plating of samples, a condition productive of higher counts than where plating is done immediately. Although it was requested that samples be taken of the filtered and untreated water, but two were received and the examination of one of these indicated less than 15 per cent removal as a result of filtration. Furthermore, as similar results were afforded by two lots of samples collected previous to the installation of the treatment, it is obvious that at

*During this period there were times when the gas absorption at the pump-well was not quite complete and a little chlorine was lost into the atmosphere. While the loss was apparently inconsiderable, this was effectually remedied by the installation of a return pipe to the absorption tower. At the present time the odor of chlorine about the station is wholly absent.

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present no great reliance can be placed upon the operation of the filter, aside from the removal of suspended matter, although it is reasonable to believe that much of the time it may be doing good work, bacterially.*

In any comparison of the relative amounts of actual chlorine consumed at Lakeport and Somersworth, it should be understood that the two supplies are far from similar in character. The latter, highly colored as it is and carrying much more organic matter, would necessarily demand a larger proportion of any form of disinfectant.

STERILIZATION BY THE USE OF BLEACHING POWDER AND CHLORINE.*

By Charles D. Howard, *Chemist.*

Wherever the source of water supply contains very much suspended matter or is highly colored, filtration (with alum for color removal) is the sole remedy. In fact neither the violet-ray nor the ozone treatment previously cited can be carried out successfully in the absence of previous filtration.

There are, however, two circumstances where the use of a cheap disinfecting agent has proved itself of very great value. One of these is auxiliary use in conjunction with a filter system that is overloaded or not working properly; the second is concerned with those cases, very frequent in New England, where the water, though clear and comparatively clean, is, nevertheless, not quite safe for use in the raw condition. An example of the first is to be found at Somersworth, where treatment with chlorine gas was recently installed. The Laconia supply furnishes an example of the second kind of cases, the bleaching powder treatment being here used as a precautionary means to ensure the entire safety of Lake Paugus water.

Bleaching Powder Treatment Extensively Used.

While the application of chlorine gas direct is a comparatively new and untried proposition, the use of bleaching powder, or "chloride of lime" (calcium hypochlorite), in this connection has steadily advanced from the time of its first successful employment in 1908 for treating the water supply of the Chicago Stock Yards (Bubbly Creek), and today we find this process to be in common use throughout the country—one that has become thoroughly established in the opinions of sanitary engineers as an exceedingly valuable agency in water purification.

Recently the Ohio State Board of Health sent out a circular letter of injuiry addressed to the water departments of cities of 25,000 population or over. Of the ninety-nine cities replying and having surface water supplies, thirty-eight were using the hypochlorite treatment. These cities were unanimous in endorsing its value. As a matter of fact, the number of places

*See tabulated analyses under "Somersworth."
†From Bulletin for July-October, 1913.

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actually employing this treatment is much greater than the above figure, if we consider *all* cities and towns.

As a result of this inquiry, the board concluded that hypochlorite not only "usually causes no tastes, odors, or corrosive action when used in small amounts" but also that "it is effective in removing a large percentage of the bacteria in water and practically all those of intestinal origin." It further concluded that "though hypochlorite has been found effective in cases of emergency, its constant use is advisable, especially with unsafe or dangerous supplies, for the reason that it is better to prevent epidemics than to attempt to destroy them when they occur."

Possibly the most notable as well as the example of largest use of bleaching powder for water purification is that in connection with the New York City supply, involving the treatment by this method of upwards of 380 million gallons daily of Croton water. In this case the treatment, now being installed, is mainly precautionary, as the water is not subject to gross contamination.

Nature, Mode of Action and Cost of Bleaching Powder.

Chemically, bleaching powder consists of chlorine gas in combination with slaked lime, the chlorine being prepared by the electrolysis of common salt. It is packed in iron drums holding 300 pounds and upwards, the cost at wholesale being now quoted at less than 1½ cents per pound. The effectiveness of bleaching powder depends upon its "available chlorine" content. which should not be less than 35 per cent. The mode of chemical action consists in free hypochlorous acid being liberated by the natural carbonic acid of the water. The former acid, in the presence of organic matter, immediately decomposes, with liberation of active oxygen. It is oxygen, therefore, rather than chlorine, which actually accomplishes the destruction of organic matter and bacteria, and this is true as well where chlorine gas is used as the medium of sterilization.

For the benefit of those who would object to thus "medicating the water supply," it may be stated that the quantities used are exceedingly minute, and not only this but the process involves the complete decomposition of the chemical, changing the latter over into inert mineral salts. One, therefore, does not actually drink "chloride of lime" in water thus treated, even in minute traces; neither is there any likelihood, under the method of use, of any odors or tastes of chlorine—any such complained of being rather the result of suggestion, based upon knowledge of the nature of the treatment being used.

Rates of Treatment.

Thus with the Laconia supply it has been found that good results are attained at the present day by the use of less than three pounds of bleaching powder per million gallons, or only about a quarter of a pound to a million

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pounds of water. When it is appreciated that the total mineral ingredients of our surface waters average not far from 20 pounds per million pounds of water, and that the naturally present chlorine amounts to one or two pounds, it will be seen that the addition thereto of one tenth of a pound of chlorine, combined in the form of harmless salts, is a matter of no moment.

It is true that the present rate of treatment at Lakeport (0.10 parts chlorine per million) is abnormally low, rates of from 0.2 to 0.5 parts of available chlorine (equivalent to 5 to 12 pounds of bleach per million gallons) being more common. The average found by the Ohio board in the case of 34 cities was 8.66 pounds per million gallons, corresponding to 0.36 parts of chlorine per million parts of water. Much larger amounts than the above have been used without the development of odor or taste.

The Lakeport Hypochlorite Plant.*

At Lakeport it was planned at the start to treat at the rate of 0.20 to 0.25 parts of chlorine. Later, a new centrifugal pump was installed having a working capacity of 147,000 gallons per hour—nearly two and one half times that of the old one. Notwithstanding this, however, the rate of solution delivery does not seem to have been materially increased to meet such increased rate of pumping; and furthermore, analysis of the bleach solution showed it to fall materially short of the strength specified, the result being that the actual rate of treatment at the time of the writer's visit was found to be equivalent to .09–.10 pars chlorine only, or equivalent to but about two and one half pounds of bleaching powder per million gallons. Nevertheless, as our examinations just previous to this time had demonstrated satisfactory bacterial removals, the above rate has been allowed to continue. For counts afforded see tabular matter under "Laconia."

From the table it is apparent that the bacterial population of Lake Paugus varies considerably and that at times it is quite high, notwithstanding its comparative freedom from organic matter and general good appearance. It is probable that the pollution entering through the Weirs Channel is pretty well spent by the time the current reaches the intake, although that there is a certain appreciable amount of danger from this sewage entrance, especially during the summer months, cannot be questioned. Experience has shown that the water of lower Lake Paugus is at times very rich in microscopical organisms, such having given some trouble in the past from development of odors and tastes. For the future prevention of the latter, this treatment is admirably adapted.

Considering the absence of filtration and the very small proportion of bleach used, the results shown in the table are considered remarkable. In most cases the bacterial removals are close to 99 per cent, frequently more than this, and in no case did one cubic centimeter of the treated water afford a presumptive reaction for B. coli. It is true, because of the large number of bacteria originally present, a few of the results indicate a larger

*A description of this plant will be found in the Report for 1911-12.

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residual number growing upon gelatin than is generally allowable in connection with the best filtration practice. However, these forms may be considered harmless. It will be noted that those growing at body temperature, which include the forms liable to make trouble, are in every case present in the treated water in small numbers.

This fact would seem to bear out the claim made for the treatment, that the dangerous pathogenic varieties are the first ones to succumb and the most readily disposed of. Laconia has had but very little typhoid fever in the past. However, the claim has lately been made that the number of cases of bowel disturbance has been notably less this season than usual, and it is believed that there may be a direct relation between this fact and the sterilization treatment applied to the water supply.

Emergency Disinfecting Apparatus.

Water systems are liable at times to contamination as a result of temporary pumping from impure or suspicious sources in consequence of fire or serious drouth or because of some accident. Elsewhere the value has been recognized of immediate means of rendering such water safe, and already quite a number of state boards of health have adopted the plan of keeping portable disinfecting outfits in reserve. This board has recently had such an outfit constructed along the lines of that in use by the Virginia Health Department, the object of such being partly for the emergency use of any water works suddenly finding itself in need of this service, partly for educative purposes with a view to familiarizing local departments with its nature and the desirability, just as with fire apparatus, of having such an equipment on hand, wherever the character of the supply is such that temporary contamination is liable.

This outfit,—the cost of which, inclusive of a porcelain-lined feed tank with hard rubber float valve and orifice, is about $60,—consists of three hard-wood barrels of about 50 gallons capacity, serving respectively for mixing and storage, together with the feed regulating device. The mixing barrel is provided with stirrers operated by a hand crank and gears. The inside of these barrels as well as all metal work are protected from corrosion by two coats of asphalt paint. The piping is of brass, which resists corrosion better than galvanized iron. The bends are formed with tees rather than with ells, in order to facilitate cleaning out.

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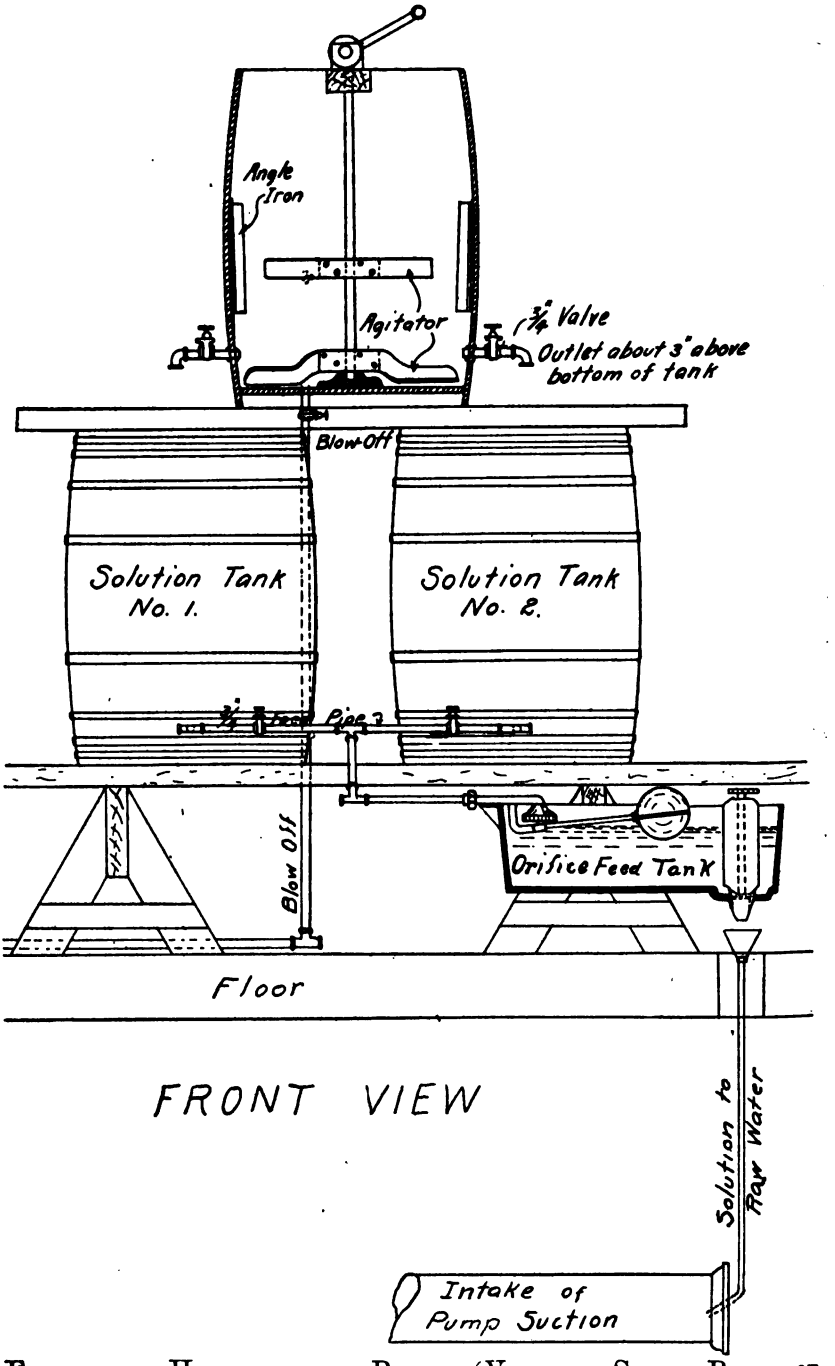

EMERGENCY HYPOCHLORITE PLANT (VIRGINIA STATE BOARD OF HEALTH.)

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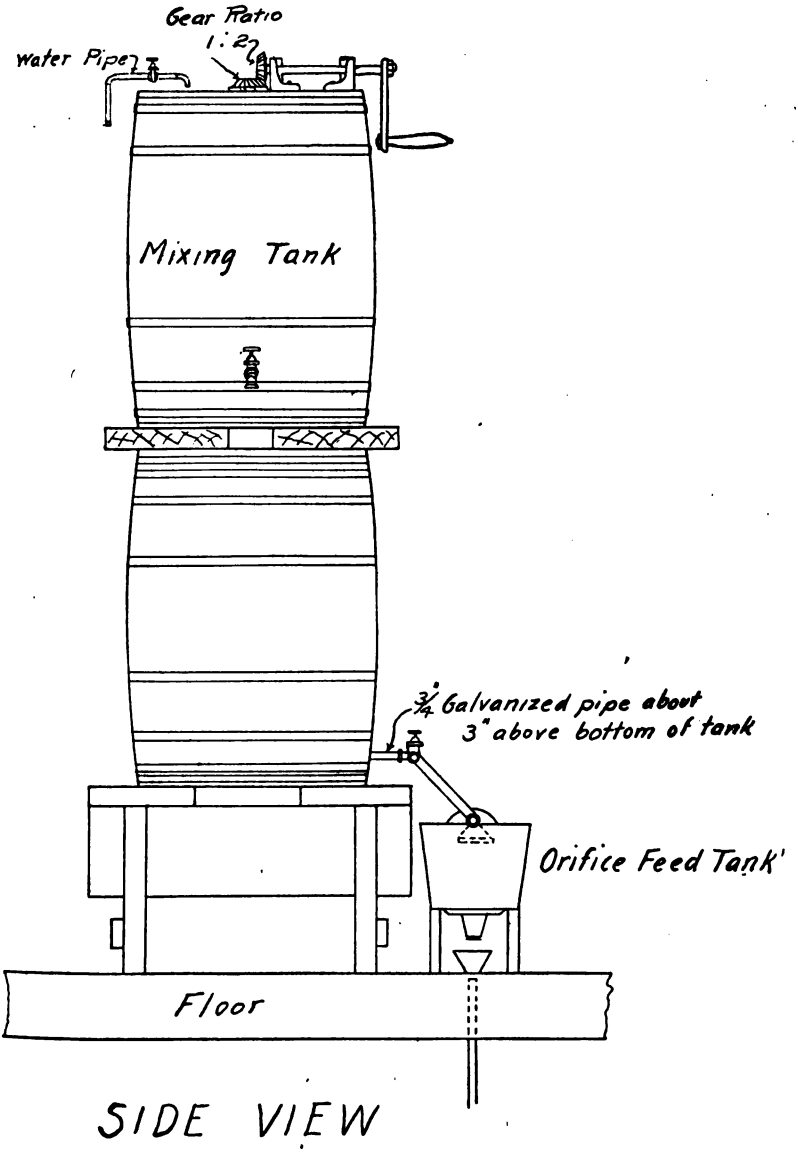

APPARATUS IS READY TO SHIP AND PLACE IN OPERATION FOLLOWING A FEW HOURS' NOTICE.

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Bleaching powder has quite a corrosive action upon both iron and soft wood. Cement should always be adopted for permanent construction, although oak and cypress will last for some time. The most resistent common metals are bronze and brass. Hard rubber is unattacked.

To operate, the amount of bleaching powder required for a half day or day's run is placed in the mixing barrel, water added to about half full, and the mixer operated for several minutes.* If desired, water may then be added until the barrel is nearly full, the stirring continued, and the contents allowed to settle until perfectly clear before drawing off into one of the storage barrels. In order to ensure continuity of operation, the other barrel is filled in the same way and kept in reserve.

Liquid Chlorine and Bleaching Powder Treatments Compared.

As regards the relative cost of bleaching powder and liquid chlorine, inasmuch as about three pounds of the former are equivalent in chlorine value to one pound of the latter, the cost per unit rate of treatment, using liquid chlorine, is approximately double that for bleaching powder, the actual cost of the former being ten cents per pound. However, against such extra cost should be credited the expense saved of constructing housing for the hypochlorite treatment, also the labor of mixing, removal of sludge, etc., in the latter case.

A further advantage is in the fact that the process requires practically no attention, it being merely necessary for the engineer, before starting the pumps, to turn on the absorption water and open the cylinder valve. And assuming that the regulator continues to work properly, the application is more constant and certain, in unskilled hands, than it is liable to be with hypochlorite—a substance prone to rapid deterioration.†

A final advantage is in the complete absence from the pumping station of the vapors of chlorine—disagreeable to inhale and corrosive of polished metal work. Experience shows that unless there is a special system of ventilation, the operator of a hyperchlorite plant is liable to find the mixing process productive of headaches. However, this difficulty is insignificant in the case of small works.

Limitations of Sterilization.

It may be well to emphasize that the use of hypochlorite or chlorine, as well as other methods of sterilization, do not afford complete substitutes for filtration. Such treatments serve in no degree whatever for the removal of either turbidity or color, so that where the raw water is appreciably dirty or highly colored, filtration will always be indicated. It might also be emphasized as regards color that the slow system of filtration cannot usually be depended upon for the removal of more than about one third of such. For this condition the application of a chemical coagulant—ordinarily in conjunction with rapid filtration—is the only remedy.

*In the absence of a mechanical mixer, the powder should be thoroughly stirred with a small amount of water (½ lb. per gallon) before diluting.

†The chlorination treatment apparatus recently installed at Woodsville embodies a number of valuable improvements over the Somersworth construction.

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Purification Methods not Infallible.

In conclusion, a word of consideration may be given to the argument which the cynically inclined are fond of advancing against these processes of purification—that is, that their value is altogether dependent upon the faithfulness and intelligence of those in charge. This is true, though no less so of the older process of filtration than of the more modern methods of sterilization. No purification plant will run itself. In this regard, as in railroading and other activities demanding constant vigilance, the human element is a factor which will always have to be reckoned with. And a difficulty attaching to positions of this character—indicative of the requirements not only of intelligence but of a peculiarly high degree of faithfulness—is in the fact that the result of any faulty operation of water purification plants is very apt to be inapparent to both operator and public—at least for a time.

HOUSEHOLD FILTERS.*

The use of a filtering device attached to the kitchen water faucet is a very common practice. Such "filters" are frequently peddled by agents, and unfortunately are apt to be sold under exaggerated claims for their value. But whether these devices depend for their effectiveness upon sand, charcoal, cotton pads, or very fine wire cloth, it should be understood that for the purpose of rendering a suspicious water safe—that is, for the removal of harmful bacteria —they are of no value whatever. However, if cleaned sufficiently often, their use may at times be advantageous for the elimination of suspended matter and such forms of animal life as occasionally find their way into the house main from a surface-water supply. In short, they are strainers—nothing more.

The more expensive purifiers of the Berkefeld or Pasteur type are in a different class, these being true filters. Such consist of hollow cylinders, or "candles," formed of unglazed baked earth, contained in metal jackets and arranged ranged to attach to the faucet. Properly cared for, they are of actual service for water purification. Unless, however, filters of this kind are taken apart, cleaned and thoroughly sterilized every day or so—and herein is one of the chief fallacies concerning the practical value of the household filter—they are apt to be even worse than useless.

Where no water pressure is available there are on the market combination filters and "coolers" consisting of jars of unglazed earthenware and operating on the Berkefeld principle. Here too, the weak point is in the fact that such devices are in practice apt to be neglected and the filtering medium may even become a nesting place for germs. Thus it has been demonstrated that, under certain conditions, water passed through one of these domestic filters may contain more bacteria than it did in the first place.

Recently there has come into use a portable filter designed for the rapid filtration of comparatively large volumes of water, such being originally in-

*From Bulletin for July-October, 1913.

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tended for the use of troops in the field. This apparatus, which operates on the principle of the mechanical filter, consists of a large galvanized iron tank, with two smaller mixing tanks. To the raw water contained in the latter is added a dose of about five grains of sulphate of alumina, together with a sufficient excess of alkaline carbonate to insure complete precipitation of the alumina. After mixing thoroughly, the treated water is emptied into the large tank, from which it is eventually drawn by means of a brass syphon tube. The short limb of the latter terminates in a metallic cage around which a thick pad of freshly sterilized flannel is securely bound. The floccules of alumina and organic matter pick up the bacteria and all are held back by the flannel. While it is possible that, in addition to decolorizing and clarifying a comparatively dirty water, this apparatus is capable of doing good work bacterially, yet a circumstance against it is in the fact that the relatively large dose of alum recommended, necessitating as it does an accompanying addition of alkali, involves the presence in a gallon of the filtered water of a number of grains of Glauber's salt—a drug which, though of value as a constituent of a medicinal water, is objectionable in a regular drinking supply. Though such an apparatus would be of value for clarifying a physically dirty water, it is probable that for the purpose of merely rendering safe the comparatively clear waters of this section, the application thereto of a homeopathic dose of bleaching powder solution would not only be quite as effective and satisfactory, but much more convenient*

REPORT CONCERNING THE CHARACTER OF SPRING WATER SOLD IN CONCORD.

APRIL 9, 1913.

An examination of samples of Crystal spring water sold in Concord, together with an investigation of the source, revealed the following facts, as reported by the chemist of the Board under date of April 9, 1913:

In the first table of analyses, No. 1651 and No. 1652 were submitted by Mr. Robinson November 7, 1903, under the designations, "Spring No. 1" and "Spring No. 2," the latter in all probability being the same source as No 10862, mentioned later.

Nos. 10862 and 10863 were collected by myself April 3, 1913, the first from the spring on the flat, between the village and the railroad tracks, the second from a spring located in the woods east of the village.

	No. 1651	No. 1652	No. 10862	No. 10863
Odor	0	0	0	0
Color	0.0	0.0	0.05	0.0
Turbidity	0.0	0.0	0.0	0.10
Sediment	0	0	v.sl	v.sl
Free ammonia	0.0020	0.0020	0.0006	0.0006
Albuminoid ammonia	0.000	0.0020	0.0010	0.0008

*A recent application of this principle to the purification of army and camp water supplies consists in the use of a waterproof bag provided with a faucet in the bottom. After filling this bag with water and hanging it up, the contents are treated with a dose of hypochlorite.

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Chlorine	0.20	0.75	1.30	0.25
Nitrates	0.020	0.150	0.035	0.005
Nitrites	0.000	0.000	0.000	0.000
Solids	3.40	7.70	9.4	
Hardness	1.1	2.9	2.7	0.3
Colon bacilli	.....	.....	neg	neg

(The first and fourth and the second and third represent the same sources.)

In the following table, No. 10753 represents water collected from spring at State Prison Feb. 13, 1913; No. 10759 is Crystal spring water as delivered in carboy by Batchelder & Co., Feb. 15, and No. 10769 is the same, delivered in carboy Feb. 21, 1913.

	No. 10753	No. 10759*	No. 10769*
Odor	0	0	0
Color	0.0	0.0	0.0
Turbidity	.....	.....	....
Sediment	0	0	0
Free ammonia	0.0006	0.0008	....
Albuminoid ammonia	0.0006	0.0008	....
Chlorine	0.18	1.33	1.35
Nitrates	0.003	.....	....
Nitrites	0.000	0.000	....
Solids	3.5	11.5	11.1
Hardness	0.1	3.5	3.7
Colon bacilli	neg	neg	neg
Total bacteria per cc	.....	.....	20000

The above analyses indicate that the spring in the woods represents water of excellent quality (No. 1651, first table), though not, as a whole, being quite up to the excellence of the Prison spring water (10753). It is apparent from the analyses of the lower spring water (Nos. 1652 and 10862) that the water delivered by Batchelder & Co. (10759 and 10769) was altogether from this source. This latter spring is located near the base of the hill that extends from the main street to the railroad track. The immediate vicinity is pasturage, but there is chance for drainage from the numerous stables, etc., located just above.

This spring is much larger than the spring located in woodland east of the village, and notwithstanding its comparatively inferior quality, is apparently the one mainly drawn from for the sale of water. The criticism that is raised against this source is, not that the water is likely to prove distinctly unsafe for drinking purposes, but that, in view of the proportion of chlorides, nitrates, mineral salts, etc., it is not of the high degree of excellence represented; that, notwithstanding its appearance is better, it is really neither better nor safer on the whole than is the water of our city supply.

Water from both these springs is conducted to the house, partly through cement-lined iron pipe, partly through wooden pipe, and there is a shut-off on each so that either can be drawn from at will. The bottling arrangements

*See also results of later analyses tabulated under "Concord."

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demand criticism. The bottling is done in a wagon-shed and there are no facilities for proper washing and sterilizing of the bottles. The need of improvement in this respect is further evidenced by the high bacterial count afforded by No. 10769. The sale of such as "pure spring water" should not be tolerated. As the open empty bottle standing in the home is liable to contamination or defilement in a great variety of ways, the thorough cleaning of such, using hot water, should be observed in each case before refilling. It is asking nothing unreasonable to require that for the purpose of bottling there be provided a room specially partitioned off and provided with running hot water.

TROY.

On June 23, 1913, inspection was made of two sources under consideration in connection with the introduction of a public water-supply system.

These sources are (a) Mitchell Brook, southwest of the village, and (b) Fassett Brook, having its origin to the northeast in the base of Mt. Monadnock. Previous to this date samlpes had also been collected from three other brooks, viz., Whitcomb, Dexter and Ratikan, but these sources have since been eliminatetd from consideration. A survey was made of the Mitchell Brook proposition some ten years ago, and some engineering data is therefore available with regard to this source. Fassett Brook is as yet unsurveyed.

This town is much in need of a water system, many of the available wells having been condemned as polluted. A certain amount of fire protection is at present to be had from a pond in conjunction with a fire pump installed in one of the shops. This pond, however, is badly sewage-polluted, and as there is no other pond available, water supply is a matter of either sinking wells and constructing a pumping system, or the installation of a gravity system from one of the brooks, the latter being the plan most favored at present.

A complete circuit was made of Mitchell Brook, going above the head waters. The whole territory included in this watershed consists of dense woodland, down to the point where the dam for the upper reservoir would be constructed. This is at a point about one and one-half miles from the village, and a dam to afford a storage here of 1,000,000 gallons would involve a head of about 300 feet, it is estimated. In order to save the expense of putting in a full sized distributing main from this point it is proposed to conduct the water from here to a point about 1000 feet from the village through a small 6" feed pipe. This second, or distributing reservoir, the size of which is planned for 2,000,000 gallons, would not be located upon the brook but would be deflected therefrom to a plot of land 40 or 50 feet higher up than such brook. In this way, the water of Dexter Brook, a tributary of objectionable character, as well as all that from the lower watershed of Mitchell Brook, would be eliminated from this system.

The installation of a supply from this source, as also from the Fassett Brook source, would, it appears, involve thorough stripping of all the surface growth on the territory to be inundated.

(b) Inspection shows that the watershed at the head waters of Fassett Brook is much more open land, being largely pasturage. While this is the

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only objectionable sanitary feature, apparently, attaching to this source, still it is stated that but few cattle are now pastured in this locality and it seems quite probable that through purchase of the land and fencing for a sufficient distance back, this objection could be remedied without any great expense or difficulty. Here, also, two reservoirs would be constructed, partly to avoid the expense of laying large pipe, also because of the pressure otherwise involved in direct draft from the proposed point of intake. This first dam would be constructed at a point three and one-half miles from the village, the second, about one and seven-tenths miles therefrom. There are two or three cottages located on this watershed, though well back from the brook in each case.

In connection with a selection from the sources mentioned a number of factors are to be considered:

1st. Quality. Analyses of the single samples thus far collected (May 15) show:

(Parts in 100,000)

	Mitchell Brook	Fassett Brook
Odor	sl. swampy	none
Turbidity	very slight	very slight
Sediment	sl. flocculent	v.sl. flocculent
Color	0.40	0.07
Total solids	3.0	2.8
Fixed solids	2.0	1.8
Hardness	0.1	0.1
Free ammonia	0.0010	0.0006
Albuminoid ammonia	0.0070	0.0030
Chlorine	0.07	0.05
Colon bacilli	negative	negative

It will be noted that the Fassett Brook water is very much better as regards appearance, there being nearly six times more color in the other source. In this respect, also in the low organic content, the Fassett Brook water is of exceptional excellence, while that from Mitchell Brook, as represented by this particular sample, is below the average, as to color, of our New Hampshire surface waters. Aside from the criticism previously mentioned, Fassett Brook could be unquestionably depended upon as affording a highly satisfactory supply as to quality. On the other hand, aside from the degree of color, the composition of Mitchell Brook water is not unsatisfactory and will compare favorably, as to organic content, with our other surface supplies. It is unfair to base judgment of any surface water upon a single analysis; and while it is certain that the Mitchell Brook will at all times carry more color than the other, yet it should be born in mind that the stripping treatment, in conjunction with reservoir storage, may be expected to reduce the brown tint somewhat. It might also be pointed out that, because of the more highly vegetated character of the latter source, there is much more risk of possible difficulty at times from odor and taste due to the development of organisms. It would be well, pending final selection, to have further samples from both sources analyzed.

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2nd. Quantity. It is believed that at first the number of families taking water from a public system would not exceed 100, and that the daily consumption would be less than 50,000 gallons. I am informed that the engineer who made the survey of Mitchell Brook claims that the source can be depended upon to afford a sufficient volume of water at all times, in conjunction with a storage reservoir. Without seeking to question this judgment, yet it may be stated that the flow at this time seems rather slight and as such has, I believe, never been actually measured, it would seem to be desirable to put in a weir and take measurements.

The same recommendation is applicable to Fassett Brook; for though the flow in this brook at present is of considerably greater volume than in the other, yet as this source is altogether from springs in high land, much of which is open, the possibility of a greatly reduced flow at times of drouth should not be overlooked.

3rd. Expense. Because of the increased length of pipe line necessitated, the Fassett Brook proposition would be the more expensive of the two, the actual difference in expense having been roughly estimated at as much as $20,000 in favor of the Mitchell Brook project. This difference, to be sure, if correct, represents a large item to a town the size of Troy; and yet, if we were warranted in assuming that the above analyses afford a permanently correct representation as regards the difference in quality, I am of the opinion that unless it would mean the imposition of an unwarrantably great financial burden upon the town, the increased satisfaction which would accrue from the Fassett Brook supply would thoroughly justify the extra expense. This is a matter for local decision, and as already suggested, to assist in arriving at a decision, further analyses should be made.

WILTON.

In company of Mr. W. I. Durgin of the Board of Health and Mr. E. P. Hopkins of the Board of Water Commissioners, an examination was made July 17, 1913, both of the present water supply system and of the sources now under consideration for an extension.

The present supply is taken from Gaerwin Falls Brook, the latter having its source on the eastern slope of Pack Monadnock Mt. some dozen miles to the northwest of East Wilton. The intake reservoir is constructed at a point about one and one half miles from this village. The reservoir at the present time is extremely low and is daily becoming lower, and the demand for an additional supply is urgent. At present the flow of Gaerwin Falls Brook at this point is very slight—the volume being noticeably less, in fact, than that noted a number of miles above.

It is claimed that this brook has failed largely in recent years, there very seldom being as much water available as was the case during the year the supply was installed, about ten years ago. If this is true it should prove an object lesson to towns having the matter of water supply adoption now under consideration, as regards the desirability of careful preliminary observations and measurements extending over a period of a number of years.

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Two new sources have been considered. One of these, understood to have been largely favored by the citizens because of supposed ease of availability and slight expense, is Burton's Pond, a body of water some five and one half miles from the village, whose outlet is a minor tributary (length about one and one half miles) of Gaerwin Falls Brook. The other posible source is Stockwell's Brook, so called, which is also a minor tributary of the stream mentioned.

Burton's Pond.

This source was considered in conjunction with the original installation nine years ago, a number of samples having been collected for analysis at different periods just previous to such time. By means of a motor boat I also made a thorough inspection of this pond and took a sample at a point a short distance above the dam.

Burton's Pond is an irregularly shaped body of water (inclusive of many bays or coves), the area of which is variously estimated at from 60 to 100 acres. Having its source wholly in springs, it is artificial in character, resulting from the damming up of a meadow tract something more than seventy-five years ago. The pond is controlled by private parties operating a wooden-ware mill on the stream below. Although primarily designed as a reserve for power purposes, it is chiefly valued at present as a private pleasure ground, most of the shore land being owned by a single individual.

Than Burton's Pond no better example could be found of the futility of expecting utimately to secure a satisfactory supply through the impounding of an unstripped area. Notwithstanding that this tract has been continuously flowed during a period estimated at nearly one hundred years, yet the pond is still full of stumps which only the use of dynamite would remove. Numerous slowly decaying trees and logs line the shores in places. Lily pads are noticeable. The depth is but slight, averaging about four feet, except near the dam. In spite of this, the bottom, which is covered by a dark vegetable ooze, is nowhere visible a few inches from the shore. The sample of water at time of collection exhibited a distinct yellow tint and showed the presence of myriads of minute whitish particles consisting of organisms and decaying organic matter.

Those in favor of Burton's Pond auxiliary argue that at practically no expense sufficient water could be delivered from this source to swell the main brook to normal volume at times like the present; that private ownership of water rights can in no wise be exercised as a bar against the town thus securing water for supply purposes; and that if the present gate cannot be operated, as is claimed, the water can be readily obtained by syphonage. On the other side, it is alleged that the water is not of satisfactory quality; that while an arrangement could doubtless be made with those now controlling the pond, yet past experience in this respect has demonstrated that to replace any material draft upon this body of water would require a period of a year or two, as the spring flow is but slight and accumulation extremely slow; and finally, that much better water—of a quality too

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valuable to be wasted—can be secured nearer home. As regards the second objection, I am, of course, unable to offer advice, assuming there would be any extensive use.

STOCKWELL BROOK.

It appears, however, that the board of water commissioners had already rejected the Burton's Pond project, and, through ignorance of the new law requiring the approval of the State Board of Health prior to the construction of any enlargement of a system, had made all arrangements to take water from Stockwell Brook. I found a timber dam already constructed; men were employed in stripping the proposed reservoir site, and with the arrival of a gasolene pumping engine, it was expected to have the new plant in operation immediately. Such prompt action was in fact demanded, as at the present moment the reservoir is not far from empty.

Stockwell Brook enters Gaerwin Falls Brook a few rods below the present intake reservoir and at an elevation something over one hundred feet lower than such intake. In order to utilize the water it is therefore necessary to pump directly into the main line, by which process any excess not going down to the village would be carried upward into the reservoir for storage.

Notwithstanding that the length of the principal flow of this brook is probably not much over a mile, yet at the present time there is apparenly in the neighborhood of double the amount of water that is being delivered into the reservoir from Gaerwin Falls Brook. The source is in nearby springs and most of the flow is through woodland. Unfortunately, the head waters are from open farming land, and a remarkable circumstance is in the fact that apparently at least one half of the total flow at the proposed dam—an amount equivalent to the flow of Gaerwin Falls Brook—gushes from an open slope which is fenced around and occupied as a poultry yard. This spring water is dammed up to form a duck puddle in the yard, the overflow entering the brook some fifty rods down in the meadow.

The water shed also includes in this neighborhood four or five houses and two barns. In the latter very little stock is kept. Drainage from three of the houses is such as to menace the supply in the absence of necessary improvements. Thus the sewer outlet from the Hallett Place, so called, and which serves two houses, discharges directly on the ground on a moderately steep slope possibly fifty rods from the brook. The houses in question are used for the most part only as summer residences and under normal summer weather conditions no trouble could of course arise. As, however, a heavy shower would readily carry this sewage to the brook, it is obviously essential that if this source is to be employed, cesspools of approved construction must be put in at once. A driveway through the brook at the highway culvert should also be closed.

The water of this brook at the proposed reservoir site is of excellent appearance, the gallon sample here collected appearing quite colorless and free from any suspended matter.

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ANALYTICAL COMPARISONS BETWEEN BURTON'S POND AND STOCKWELL BROOK WATER.

The samples collected at this date gave the following results upon analysis:

	(No. 11257)	Burton's Pond (No. 11258)
Odor	faint earthy	distinct swampy
Color	0.08	0.45
Turbidity	none	consid. fine veg.
Sediment	very slight	slight gelatinous
Free ammonia	0.0006	0.0006
Albuminoid ammonia	0.0016	0.0200
Nitrates	0.005	0.005
Nitrites	0.0000	0.0000
Chlorine	0.15	0.15
Hardness	0.3	0.3
Total solids on evap.	2.5	4.5
Fixed (mineral) residue	1.7	2.3
Blackening on ignition	v. faint	decided
Colon bacilli, 1cc	negative	negative
Colon bacilli, 10cc	v. faint react.	v. faint reaction
Biological examination	no organisms	organisms very numerous and varied.

The above indicates that Burton's Pond water at this time contains over five times as much color and nearly thirteen times as much organic matter as is true of Stockwell Brook. As compared with former analyses the pond water at present carries slightly more organic matter than was noted during 1904. Though not prohibitive, such amount is much above the average for our surface supplies and is, in fact, somewhat greater than any others have shown during the past year or two. At present we have three supplies that show as much and a little more color. One of these, however (Suncook), is to be abandoned at once, while the other two are both filtered. Microscopical examination of the turbidity shows the pond water to be a numerously populated aquarium of minute plant and animal life, many varieties ranging from the disagreeably odorous diatom *asterionella* up to the water scavanger *cyclops* being noted.

On the other hand, the chemical analysis of Stockwell Brook water is highly satisfactory, the degree of color and amount of organic matter being no greater than occurs in our best well waters. In fact, this is for all intents and purposes, spring water. Microscopical examination fails to indicate any biological forms in the amount investigated. Like the pond water, the sample does show a faint colon reaction on the larger quantity examined. Such might be due to contamination from the duck pond, or in both cases to a little agricultural drainage.

The sources of actual and possible pollution on Stockwell Brook, as well as the remedy therefor, have already been indicated. So far as the

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analytical findings are concerned, it would appear that the duck pond pollution is not appreciable; yet even if only aesthetic considerations were here involved, the latter are sufficient to command the elimination of this feature. So far as transmission of serious disease is concerned, undoubtedly the sewerage condition already referred to represents a much greater menace.

Burton's Pond is subject to practically no sewage contamination, the only possible sources being in drainage from a single nearby farm and that from two camp cottages. As regards this pond as a source of supply, it may be stated that while the quality will not compare with that of Stockwell Brook yet it would serve sufficiently well to "tide over" during a dry time, especially as the quality would doubtless improve somewhat as a result of flowage after leaving the pond. On the other hand, the natural character of Stockwell Brook water is of such high excellence as to make it well worth while for the town to incur some extra expense in connection with a utilization and protection of this source.

Sanitary Conditions Surrounding Present Supply.

As already stated, much of the course of Gaerwin Falls Brook is through open country, and the entrance of a certain amount of farm and highway drainage is therefore inevitable. Examination of the shores of this brook to a point in the town of Temple, some seven miles above the reservoir, showed that in quite a number of places the land is being cultivated close up to the banks. Under the law, the Board of Health has power to compel the owners to refrain from applying manure or fertilizer closer than a specified distance from the banks, and in the cases noted it would therefore be desirable for such board to serve notices upon the land owners concerned.

In two or three instances it was noted that drainage from farm buildings reached the brook, or would reach it under favoring conditions. In one such case, concerning which there was complaint a number of years ago, it was found that the situation had been remedied. Similar action should be taken in the other cases. A bad condition was noted at the Nathan Barker place, the house here being situated upon a bank not over twenty-five feet from the water, and the sink-drain discharging directly upon the ground on a slope toward the brook. A septic tank of the variety described in a recent issue of the Bulletin should be ordered for this place.

At the wooden-ware mill now owned by Dr. E. P. Frye, at Davisville, the proprietor has recently requested permission to construct two dry privies near the bank of the stream, using the removable metallic drawer type. Such permission may be granted subject to approval and oversight by the local board. Some distance above this point a cider manufacturer has allowed a large pile of apple pomace to accumulate near the brook. The removal of this should be ordered.

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Quality of Present Wilton Water Supply.

Analyses of samples collected at intervals during the past nine years indicate that the quality of this supply compares favorably with that of other surface supplies in the state. For such a supply the proportion of organic matter is inconsiderable, although at times the color is inclined to be somewhat excessive and there is some silty sediment. The present consumption is estimated at about 20,000 gallons daily, and the reservoir is not large. Consequently conditions are not as favorable as might be desired for thorough sedimentation at this point. In addition, leaves also wash from a nearby road, tend to accumulate rather rapidly in the reservoir, with the result that there is some complaint at times that the water is unclean.

In consequence, there is some agitation in favor of the installation of a filter. The operation of a sanitary filter on a gravity system for a small town involves some difficulty. In order to avoid pumping, such a filter would have to be constructed at the reservoir, and the expense involved in the necessary daily attendance would render a filter of the rapid type scarcely feasible unless one of the closed or pressure type were adopted. However, the natural falls over which the brook passes in entering the reservoir would serve admirably for delivering the water upon a couple of slow sand filter beds that might be constructed at this point, a spillway being put in and arrangement made to permit of delivering upon a single bed at a time. While such a filter would not need to be a very expensive proposition, the most advantageous operation would demand the construction of a cover—a material item of expense.

Wilton Water Supply.

On March 6, 1914, Mr. Howard, chemist of the Board, went to Wilton for the purpose of conferring with members of the boards of health and water commissioners relative to certain features of the water supply. The following report was rendered:

The primary object of the conference was to secure further information and advice relative to the availability and fitness of Burton's Pond as an emergency supply. Last season the consent of the Board was given for such use of this water and it was estimated that the period of this use was some two weeks only. It is now desired to know whether or not the Board would permit of the drawing down (necessarily in part into the reservoir) or Burton's Pond to an extent sufficient to permit of the installation of a pipe and gate at the dam, with a view to continued future emergency use of this source. Inasmuch as this water is not sewage-contaminated and as such use seems likely to be on somewhat rare occasions and for limited periods only, the reply made was to the effect that it was not believed there would be any objection to this proposition, in so far as it concerned emergency use.

Pains were, however, taken to reiterate what was stated in the report of last year concerning Burton's Pond water, viz., that such pond is the result

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of flowage of a swamp, that it is laden with decaying vegetable matter, apparent not only to the eye as a result of a survey of the shores and bottom of the pond, but also in the excess over normal of color and dissolved organic matter indicated in the water by analysis. In this respect it greatly resembles the present supply of the Suncook Water Works, the most highly colored supply in the state, and to relief from the further use of which the people of this town are now looking forward. It is quite true that its use may not be unhealthful. In fact there are a number of notable examples throughout the country where such brown colored swampy waters have been in use for years without any determinable ill effects upon the users. The point is that, according to recognized standards, such water does not constitute a good and acceptable supply, and the citizens of Wilton should not be satisfied to utilize this source in case it should later appear that it would have to be drawn upon to any greater extent than that already indicated.

In the latter event it is the opinion that the Board should give its approval to Burton's Pond only on the condition that the water be filtered. Some consideration has been given to the feasibility of installing a filter at the reservoir. There is no doubt that this could be managed advantageously at but moderate expense. In view of the cultivated character of much of the watershed of Gaerwin Falls Brook, the installation of a system of filtration or other form of purification in many cases is rather desirable, though not indispensable. Strictly speaking, for the effective removal of such a degree of color as has been found in Burton Pond, the mechanical system of filtration using alum would be far preferable to the slow sand system. But inasmuch as the former demands daily attention, the other system is more feasible for a gravity supply, and for the latter the necessary chemical coagulation of the coloring matter could be arranged for in conjunction with a properly arranged sedimentation basin. Such a system could be installed at a cost well under $5000, possibly much less than this sum could be made to suffice.

As was pointed out last year the town has in Stockwell Brook a source of most excellent quality and one very convenient to the reservoir. While there seems to be a decided difference of opinion as to the amount of water available from this source—some holding that it is far from adequate—yet the fact remains that during the drouth of last summer this brook was delivering even more water than the main Gaerwin Falls source. A local engineer estimated the flow at that time to be close to 150,000 gallons per day, a volume which alone should be much more than sufficient for the needs of 1000 users. Unfortunately there seems to have been some discrepancy between the water pumped *out* of this brook by the pumping system which the town already owns, and the volume of water available in the system, the latter not filling up to account for the apparent pumpage rate. This the engineer explains on the theory of wastage. In the light of experience elsewhere it is believed that this theory may be a correct explanation. Where a supply is unmetered there is always a prodigious waste, not only from spigots allowed to run but from failure to repair leaky or defective plumbing, as would be done with a metered supply. In fact it would not be at all surprising should it prove that the present brook

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supply would be at all times adequate were there a more careful system of inspection to rule out wastage.

While it is true that in order to utilize Stockwell Brook would not only involve some pumping but would also demand the purchase of a certain amount of property at the headwaters, yet I cannot escape the conclusion that with such excellent water almost at its doors it is but false economy on the part of the town not to assume the slight additional expense that the addition of this water to the system would involve. Finally, a third expedient meriting consideration in this connection is in the claim which is made that by extending the pipe some three or four miles up the main brook from the reservoir, (a) considerably more water will be available (there being subsequent material loss due to evaporation incident to sluggish shallow flow), (b) the water is said to be whiter and of more attractive appearance, and (c) there is the further advantage that most of the present opportunities for contamination through farm drainage would thereby be eliminated.

That any kind of a water supply will serve so long as it is not positively polluted is a notion which will be found to have its defenders in every town; but it is a highly mistaken one. No town—and especially one making any bid for summer business—should be satisfied with any other than water of the best quality. Such a supply is invariably found to be a valuable asset, one that pays well in the end. And in reality, the final net cost of a supply entitled to the rating of "excellent" over that for the indifferent or inferior grade will be found to be surprisingly small. As with most things, in considering the cost of a water supply, the cheapest in point of first cost is apt not to be the best or most economical in the end.

But admittedly, one can sometimes afford to put up with some drawbacks for a time. If the consumers are satisfied to accept for emergency use water of the character of Burton's Pond, it may be questioned if the State Board of Health would be warranted in objecting, although it may be suggested that any such permission should be conditioned on its affording no validation for any possible future more extensive use. It might further be suggested that the commissioners be required to notify the Board whenever it becomes necessary to draw from this source.

March 6, 1914.

BERLIN.

The following facts were noted in connection with an inspection made June 27, 1913, of the system of the Berlin Water Company:

Water is obtained from two sources, (a) a series of mountain brook reservoirs, (b) Androscoggin River after having passed the filters of the Burgess Sulphite Fibre Company.

Brook Supply.

Concerning the brook reservoirs, five in number, located east to northeast of the city and at distances therefrom varying from one and one-half miles (Bean Brook reservoir) to six miles (Horn Brook reservoir), the engineer of the water company has supplied the following data:

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Name	Capacity (gallons)	Elevation (feet)
Horn Brook No. 1 (South Fork)	635535	1461
Horn Brook No. 2	861075	1465
Anderson	2654450	1441
Stewart	661500	1279
Bean	1575260	1280

On account of recent raising of the dams, about twenty per cent should be added in each case to the capacities above indicated. At the Anderson reservoir a special gate permitting of direct draft to the city affords increased pressure for fire protection.

All of these brooks flow through heavily wooded country and as much of the growth is coniferous, the water is somewhat more highly colored than is true of the average New Hampshire surface supply. Both of the Horn Brook and the Bean reservoirs were visited. With the exception of the latter, all five reservoirs are remote from habitations, and danger of any sewage contamination other than might possibly arise in connection with camping or logging operations is practically nil. The Bean reservoir, being but one and one-half miles from the city, is visited to some extent by picnic parties, and has been known to be used for bathing. In view of this fact, fencing is desirable, although frequent inspection together with publication of a standing reward for information leading to the conviction of parties guilty of polluting this source, would be helpful.

The following analysis of the brook supply as drawn from a tap July 17, 1913, (no river water) is fairly typical of this supply.

Odor	none
Color	0.55
Turbidity	slight
Sediment	sl. brown flocc.
Free ammonia	0.0010
Albuminoid ammonia	0.0086
Nitrates	0.005
Nitrites	absent
Chlorine	0.10
Hardness	0.4

This water deposits more or less brown vegetable sediment and the degree of color is to be classed as high. While the above sample was without taste and showed no odor upon standing in a gallon bottle, ordinarily there is a certain amount of swampy or vegetable odor. The organic matter in this water is apparently quite stable, and aside from the matter of appearance, the character of the brook supply is satisfactory. The latter could doubtless be improved somewhat by keeping the shores better cleared than at present, so as to prevent excessive accumulation of vegetation in the standing water.

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Androscoggin River Supply.

This is represented by a portion of the clear water supply of the Burgess Sulphite Fibre Company. In order to clarify the water for manufacturing purposes the latter is passed through filters of the rapid, or so-called "mechanical" type. The Company's filter-house, situated on the bank of the river a short distance from the Boston & Maine Railroad station, contains fifty-two of these sand beds, each 15 ft. by 20 ft. It is stated that the total amount of water filtered during twenty-four hours is 50,000,000 gallons. The total area of these beds being equivalent to approximately 0.36 acres, this represents a filtration rate of about 140 million gallons per acre—day—an enormous quantity of water as compared with the normal rate for the slow type of filter, which is but one and one-half to three million gallons. For sanitary filtration the above rate is higher than the best practice with rapid filters, even using coagulant, and in this case, the process being designed primarily for manufacturing use, no coagulant is employed.

It is therefore apparent that while a satisfactory degree of clarification is doubtless effected, no continuously satisfactory degree of bacterial purification could possibly be hoped for by this process. It is universally recognized that for proper sanitary filtration by the rapid process the use of a coagulant is indispensable. While it is not denied that the present process may show very fair results much of the time—especially as the Androscoggin is not extensively sewage-polluted—yet any treatment that cannot be relied upon to afford a uniformly high bacterial efficiency *at all times* is of but little use for health protective purposes, particularly as knowledge of its use tends to convey a false sense of security to the consumers.

As regards the proportion of river water used, it is stated by Mr. Gooding, the engineer of the Berlin Water Company, that a three-days test, made during January last under weather conditions rendering an abnormally high consumption probable, showed the average total daily consumption during this period to be 1,180,000 gallons. While the rated capacity of the Water Company's pump at the filter plant is 1500 gallons a minute, the actual rate of discharge while pumping against the pressure in the main was found to be only about one third that figure (433 gallons per minute), the total daily amount pumped (during twenty-four hours pumping) being 623,000 gallons. As the ordinary duration of pumping is stated as being from 5 A.M. to 8 P.M., this would correspond to a total daily pumpage of approximately 400,000 gallons; that is, it may be assumed that in the neighborhood of one-third of the present total daily consumption is taken from the Androscoggin River.

In view of the facts above mentioned, we feel impelled to urge the adoption of chlorination for that portion of the Berlin Water Company's supply derived from the river. It seems probable that in view of experience elsewhere, a quantity equivalent to not more than 0.3 parts of available chlorine per million parts of water—possibly less—would be sufficient. This would be equivalent to about seven pounds of bleaching powder per million gallons of water treated, costing not more than 14c per million gallons.

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It appears, however, that the Burgess Sulphite Fibre Company has constantly available a solution of bleaching powder containing thirty grams per liter of available chlorine, and that this solution could be advantageously utilized for the purpose. For a treatment of 0.3 part, this would involve a dilution of such solution of 1 : 100,000, thus requiring about ten gallons per million gallons of water. This addition should be made, preferably, to the clear water well in which the pump operates. In view of the insignificant cost of such treatment and the insurance thus afforded, not only against typhoid but sundry other more common enteric disturbances attributable to polluted water, it would appear that there is no valid excuse for the city's failing to avail itself of this protection.

General Character of the Berlin Water Company's Supply.

Both the brook and the river sources represent water carrying a rather appreciable amount of dissolved vegetable matter and possessed of a comparatively high degree of color. In view of the modern demand for spring water quality in a drinking supply, a supply of the above character is inevitably sure to be subjected to a certain amount of criticism by the consumers, particularly at certain times and seasons. The presence of color is prejudicial to start with, and whenever a little taste or odor develops—as is certain to occur with even the very best of surface supplies at times—it is difficult to convince the average user that there is not something dangerous or very seriously objectionable about the water. In view of the degree of criticism which has been of late expressed concerning this supply, it is evident that the latter cannot be expected to prove very generally acceptable until the water from both sources is subjected to a process of clarification and color removal.

Forbush Supply.

A few families on the east side of the river are supplied from wells situated upon a hill back of the Boston & Maine R. R. station. While these wells were not visited I am informed by the local health officer that the water is regarded as of excellent quality and that the existence of pollution is improbable.

A small amount of water is also said to be supplied from springs located in another part of the city. It is expected that samples from the latter source as well as from the Forbush system will be submitted by the health officer during the near future. Analyses of the supply of the Berlin Water Company are made periodically.

Dead River Sewerage.

The objectionable condition presented by the discharge of sewage and refuse into Dead River was investigated. This is a small stream which flows through the heart of the city and discharges into the Androscoggin River near the plant of the International Paper Mills. While from a point near its emergence into Main street it passes through a conduit, the flow for some distance

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in the rear of Main street, as well as that through a considerable section of the thickly populated portion of the city, is in an open channel. Not only do numerous sewers discharge into the stream at various points but both the channel and its banks are extensively used as a dump for refuse. The stream being at the rear doorsteps of the Main street stores, quite a proportion of the material thrown out consists of refuse edibles, for the possession of which during the warm days, flies and small boys are ever contesting.

To the merchants affected this stream is doubly a source of annoyance, from the fact that during the late winter and spring their basements are frequently flooded with the foul water, while during the summer, the flow being then so slight as to be insufficient to properly dilute the sewage, an overpowering stench prevails.

While the conditions are such as would not long be tolerated by any self-respecting American city, yet I find that in this case the attainment of any final remedy is beset by peculiar difficulties. On account of the ledge formation the construction of a system of sewerage adequate to accommodate all of the sewage from both sides of the river would entail an expense of many thousand dollars, so the city engineer represents. Another difficulty is presented in the fact that one of the mills owns a log-floating right of way through this stream, and any covered condult system would have to be so constructed as not to hamper the exercise of this right.

Though it would seem that a conduit is the logical ultimate remedy, yet pending the construction of such, greatly improved conditions could be secured (a) by clearing out and improving the channel (b), requiring that all sewer discharges be extended to the middle of the channel, so that such discharges shall at all times have the benefit of the maximum dilution available; (c) prohibition of the dumping of refuse in or near the stream.

HAMPTON WATER WORKS.

On August 5, 1913, in pursuance of the provisions of chapter 205, Laws of 1913, in connection with a request of Hon. E. G. Eastman, a director of the Hampton Water Works, an examination was made of the plant of this company and also of a proposed extension of their source of supply.

The present source consists of wells situated in an uncultivated field near the edge of woodland, about forty rods north of the trolley line and possibly a mile back from the beach. In addition to thirteen driven wells, averaging about 18 feet deep, there are three large dug wells, 12 to 25 feet in diameter, with a fourth now under construction. Notwithstanding that solid ledge was encountered in the latter at a depth of seven or eight feet, the construction is being continued. The third well of the series, but recently completed, has proven a failure, so far as the accumulation of any satisfactory volume of water is concerned. A marsh pond a few rods east of the latter well also affords increased protection in fire emergency. This source should not be used for drinking purposes.

The water is pumped by electric current to a steel standpipe, pumping being continuous during the twenty-four hours. The quality is highly sat-

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isfactory, particularly for a coast water, an analysis of a sample collected by the board of health April 14, 1913, being as follows:

	Parts in 100,000
Odor	None
Color	None
Turbidity	None
Sediment	None
Total solids	9.5
Fixed solids	6.0
Free ammonia	.0014
Albuminoid ammonia	.0020
Nitrates	.020
Nitrites	.0000
Chlorine	1.65
Hardness	2.6
Zinc	0.1
Colon bacilli	Negative

Except during August, the normal daily consumption during the season is about 150,000 gallons. The August requirement, however, is 200,000 gallons or more, and as the present well supply not only cannot furnish this additional amount, but is of late seriously below its normal capacity, the immediate acquisition of another source has become imperative.

The supply which has been provisionally adopted consists of Nilus Brook, so-called, a small stream to the north of the pumping station. The proposed point of intake is in meadow land belonging to J. W. Mace, and is 2,000 feet from the station, it being planned to construct a temporary basin of lumber and to pump the water from the latter into one of the new dug wells by means of a gasolene engine, through 2-inch pipe laid on the surface of the ground. Mr. A. W. Dudley, Engineer, has estimated that the brook will supply upwards of 200,000 gallons at the present time.

A sample of this water, collected August 1, afforded the following analysis:

WATER FROM NILUS BROOK.

	Parts in 100,000
Odor	v. sl. marshy
Color	0.05
Turbidity	slight
Sediment	mod. flocc.
Free ammonia	0.0020
Albuminoid ammonia	0.0020
Nitrates	0.005
Nitrites	0.0000
Chlorine	1.45
Total solids	13.5
Fixed solids	9.5
Hardness	4.6
Colon bacilli	strongly positive

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The above indicates a spring water that has taken up but little nitrogenous matter and practically no color during its surface flow. Much of the sediment, carbonaceous in character, was undoubtedly mechanically introduced during collection of the sample. The only serious feature about the analysis, preventive of a report of "good water," being rendered, is in the decided reaction which this sample affords for colon bacilli.

The brook has its source in spring-heads about two miles from the proposed intake. An inspection of this and of a small tributary showed the existence of two farm houses on the water-shed. On one of these farms, known as the Burlingame or Perkins place, there is a narrow strip of pasturage extending for a number of rods along one bank of the brook, the line fence being at the water's edge. At one point some ten feet from the brook a small spring issues, at which it is apparent the cattle are accustomed to drink. The farm buildings are less than fifty rods above, on a gentle slope, and there is a possibility of some wash from the barn yard reaching the brook following heavy showers or during rainy weather. Some four or five vegetable plats were also noted at points close to the brook.

It is therefore recommended that the company ultimately purchase the pasturage strip referred to—at least the lower half of such—and also take measures for the prevention of any future application of stable manure or insecticides within a fixed distance from the brook (Chap. 108, sect. 13, Public Statutes.) Pending this and the making of further examinations to determine the frequency and extent of the contamination by colon bacilli, in order to permit of immediate use in this emergency, the superintendent has been directed to treat the brook water as pumped to the well with a solution of chloride of lime at the rate of one pound to 100,000 gallons. While, in my opinion, there is no danger of any specific disease infection from this source, yet in view both of the analytical and inspection findings, the above precaution is warranted, to insure there being no chance for question as to the fitness of this auxiliary source for drinking purposes.

Hampton Water Works.

(Second Inspection.)

An examination June 30, 1914, of conditions in connection with an extension of the present Hampton Water Company's system showed the following facts:

The present driven well system, for some time inadequate for the demands of patrons, is being extended so as to supply water to residents not only of Hampton Beach (the original extent of the system) but those of Little Boar's Head, Hampton Village, and Rye Beach. For this purpose, Marston's spring, so called, is being developed. This is a very large spring, of considerable local repute, situated on the boundary line between the towns of Hampton and North Hampton and at a distance of about two miles from the shore. The elevation is about 85 feet, constituting it the highest point in the vicinity. The neighborhood of the spring (of which the company has acquired fifty acres)

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is unpopulated and is for the most part covered by a growth of timber and low trees or bushes. The "spring" in reality consists of a large number of small springs all issuing within a small area and constituting the chief fountain head of Dow River. The maximum available daily flow has been variously estimated as being from one million to two and one-half million gallons. An analysis of this water made during 1902 at the State Laboratory of Hygiene indicated excellent quality. Further analyses will be made just as soon as samples free from the effects of the present construction work can be collected.

A collecting basin is now under construction at the springs. This will be forty feet in diameter, will be covered and will have a capacity of 350,000 gallons. Near by is also to be constructed a 300,000 gallon steel standpipe, 25'x80', supplementing the present storage, which is a standpipe at Hampton Beach 15'x90'. It is claimed that the pressure at the service taps will be not less than 40 lbs., with a maximum of 50 lbs. The pumps will be operated both electrically and by oil-burning engines, and these will be depended upon to furnish the necessary increase of pressure in the event of fire.

It is expected that the supply available from Marston Spring will be more than necessary for the total daily demand at all seasons, and accordingly active use of the present pumping station at the Beach will be discontinued, the latter being, however, kept in readiness at all times for immediate emergency use.

Salem Water Supply.

On July 22, 1913, in company with Dr. L. F. Soule and Mr. W. E. Lancaster, members, respectively, of the Board of Health and Board of Water Commissioners of the town of Salem, an inspection was made of the general sanitary conditions of Canobie Lake, the source of water supply.

This is a lake of some 400 acres in area, the latter being about equally divided between the towns of Salem and Windham. The shores are of clean sand or gravel, and the shallows for the most part present but little evidence of living or decaying vegetable growths. Unfortunately, this is not so true at the point of intake, the bottom in this vicinity being covered with a black deposit of humus-like character.

The lake has one outlet, Policy Brook, emerging from the southeast side, a few rods below the park, the right to draw down the lake level to a certain point through this brook being owned by a Methuen (Mass.) company.

Amusement Park.

The amusement park is located upon gently sloping ground upon the east side of the lake, occupying perhaps twenty-five acres. As it is reachable by trolley from various New Hampshire and Massachusetts points, this park has become a popular excursion resort, accommodating thousands daily during the season. In addition to a large restaurant and the usual equipment of theatre, ball ground, bazaars, refreshment and entertainment booths, and stable, there is a swimming pool of 360,000 gallons capacity.

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Mr. D. F. Bowser, the present superintendent of the park, has recently been appointed a member of the local Board of Health. To his credit and that of the management, it may be said that apparently every effort is being made for the maintenance of the best possible sanitary conditions and for the protection of the lake from pollution. In this respect, conditions are undoubtedly the equal of those to be found almost anywhere—far better than at many other resorts of such character.

The sanitary arrangements are rather elaborate, and their installation has undoubtedly involved considerable expense. The drainage from both of the public toilet houses, as well as that from the kitchen and bottling plant, and a number of private closets, is conducted to a tight cesspool, or catch-basin, about sixty feet from the water. From this point, by means of a centrifugal pump, the liquid portion is pumped two or three times daily up to an elevation in the rear of the park, where it enters a series of three cesspools, constituting a septic tank. From the latter, the effluent passes to an under-drained filter bed, the final effluent reaching the brook previously mentioned.

The solid matter taken from the catch-basin about once a fortnight, is removed to a depression some 500 or 600 feet from the water's edge, where it is composted with a manure from the stables, and is eventually applied to the grass plots. This feature calls for some unfavorable criticism. In the first place, although the place where this solid matter is deposited is actually away from the lake, yet its trend is into a run which leads into the lake at a point but a short distance from the the supply intake. For this reason, the lower side of this tract should be provided with a tight embankment, for the purpose of preventing wash therefrom during showers or rainy weather.

In the second place, the practice of applying night soil to the slopes draining into the lake calls for emphatic condemnation. While there is a system of storm sewerage, the latter discharges directly into the lake; but even if it did not, it seems to me there is too great risk involved in the practice involved in the practice of fertilization mentioned. It ought to be possible to sell this manure, devoting the proceeds toward the purchase of mineral fertilizers.

The pumping equipment of the park consists of the sewage pump mentioned; the supply pump which daily removes 60,000 gallons for drinking purposes; also a 20 H. P. centrifugal pump used for filling the swimming pool. These centrifugal pumps, notwithstanding their small size and power, are remarkably efficient and are now rapidly replacing the older and ponderous piston type in pumping stations. The one in question has a capacity of 600 gallons per minute, although it occupies not more than two cubic feet of space.

The swimming pool, which is said to be completely refilled daily, is emptied through a special sewer leading into the outlet brook. There seems to be no serious obstacle to prevent the storm sewerage previously mentioned from being conducted into this line, instead of discharging directly into the lake, as at present. In my opinion, such connection should be made.

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Cottages.

It is stated that the present number of cottages on the lake is approximately 160, 125 of which are on the Salem side. The number is increasing, as new cottages are building each season.

Proceeding from the brook to the Windham boundary a general observation was made of the sanitary conditions about the cottages on the short, as well as visiting a few on the Windham side. Considering the comparatively thickly settled condition and the number of persons frequenting the shores, it may be stated that as a whole the situation is fairly good. While a few offenders were noted, as a rule the 75-feet requirement with respect to cesspools and closets seems to have been observed. At some points, by reason of the steepness of the slope, the drainage construction has evidently proven somewhat of a problem, although it was noticeable that in possibly a majority of cases, even where no such difficulty existed, the property holder, accepting the 75-feet requirement as an actual rather than a minimum requirement, has made the distance neither more nor less.

The water supply of the cottages is mainly derived from wells, although a number draw from the lake. The wells, which are generally of the driven type, are apt to be located on the route from the rear door to the closet, and as the general trend of the ground water is toward the lake, it would appear that in a number of instances the chances for contamination are excellent.

Boating and Bathing.

Naturally, the amount of boating is quite extensive. In addition to the public boat house at the park, there are quite a number of private shelters for launches and row-boats. There is also considerable fishing.

Although there appears to be some vigilance on the part of the Board of Health and the Park authorities to prevent bathing in the lake, one party having been prosecuted for this offense a few days previous to my visit, yet from conversation with various persons it would appear that this practice is still indulged in to some extent. A favorite place for bathing, one that offers comparative immunity from detection, is said to be the boat houses. However, it is asking not a little from the numerous youths and children, who are spending their days almost within falling-in distance of the water, that there shall be no bathing. While there is a standing reward for information leading to conviction, yet it is doubtful under the circumstances if anything short of three or four officers on constant duty would serve to entirely check the practice.

Source and Character of Water Supply.

The intake is situated in a cove on the east shore, at a point slightly more than a quarter of a mile north of the park. As it is probably true that there is a general drift of the water from the north shore toward the outlet below the park, some slight protection to the quality is afforded in this fact. The mouth

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of the intake is about one hundred feet from shore, and is in six feet of water at normal level. As previously mentioned, the bottom of the lake in this section tends to be somewhat muddy, and a few lily pads were noticeable. The following analysis is of a sample taken from a tap July 16, 1913, and is fairly representative of the quality:

	Parts in 100,000
Odor	Decidedly aromatic
Color	.18
Turbidity	v. slight
Sediment	sl. flocculent
Free ammonia	.0010
Albuminoid ammonia	0.0020
Nitrates	0.005
Nitrites	0.0000
Chlorine	0.45
Total solid residue	3.2
Hardness	0.3
B. coli	Negative

Although analyses have, with few exceptions, indicated a water comparatively low in organic matter and color for a surface supply, yet generally the odor, due to decaying vegetable organisms and plant debris, has always been rather decided, having been variously classed as "musty," "swampy," vegetable," "marshy," and "aromatic."

An interesting feature is the gradually increasing chlorine content, explainably only by a slowly increasing degree of seepage resulting from expansion of the shore population. Thus, starting with 0.21 parts, the amount recorded in 1901, the proportion of chlorine has steadily and almost uniformly risen until at the present time it is more than double that first noted.

The suggestion has been made that by bridging the mouth of the cove with a sand-filled breakwater, or causeway, protection would thus be afforded from the contaminating influences elsewhere, the idea being that the water in seeping or diffusing through such an embankment would be filtered from sewage bacteria. This is in effect the filter gallery idea carried out on a comparatively large scale, although the filter gallery system has been pretty thoroughly discredited, partly on account of undependable efficiency, due to channeling, partly because of the tendency of the filter layer to become impenetrable through silting up, such clogged condition being practically impossible of remedy. However, in this instance the filtering area would be relatively very large, so that, considering also the clear character of the water, the failure of an adequate volume to penetrate would be very improbable, and while there would undoubtedly be a certain amount of free passage, resulting from channeling, yet I am of the opinion that in the absence of any very extensive degree of contamination, such a device would tend to materially reduce the danger of infection. However, it should be understood that an embankment of this kind would not serve every purpose of a scientifically constructed and operated filter.

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Were conditions mechanically favorable therefor, I would, considering all the circumstances, emphatically recommend sterilization of this supply during the summer months. Such a treatment would cost less than ten cents a day were it a pumping system, with the services of at least one man continuously available. On account of the fact, however, that, being a gravity supply, no daily supervision is at present demanded, and such a treatment would have to be either injected under pressure, or else applied at the pond, the problem of application is considerably complicated.

Recommendations.

It is recommended:

1. That the present practice of using night soil for fertilization at the park be discontinued, and, further, that the storm sewerage system be connected with the waste pipe from the swimming pool.

2. That copies of the sanitary regulations be not only posted at intervals around the shores of the lake, but that one such, in placard form, be handed to each cottage holder for tacking up in the kitchen or some other convenient place.

A large number of the cottagers are apparently not only unaware of the existence of such regulations, but are ignorant even of the fact that the lake water is a public drinking supply.

3. That the entire shore be periodically patroled by some person during the season, one of whose duties should be the taking of a detailed census of the shore population, including also a record of the sanitary conditions at each cottage or place. Being deputized by the sheriff would give such an officer jurisdiction over both shores.

4. That the matter of protection by sterilization with bleaching powder or liquified chlorine gas be given special consideration by the local authorities, with a view to determining the feasibility of such under the conditions involved. The application of such a treatment is very much to be desired.

August 5, 1913.

EXETER WATER SUPPLY.*

On August 5, 1913, a visit was made to the filter plant of the Exeter Water Works and a conference held with officials of the company relative to a recent deterioration in the quality of this supply. The latter has been described in a previous report (Report State Board of Health, 1909–10, p. 235). During the past two months there has been considerable complaint on the part of consumers on account of the character of this water, the condition being described as "yellow" and "dirty." During the past few days the quality has greatly improved, being now practically normal.

*This report and the letter from Professor Weston following should be of interest to the citizens of Newmarket, inasmuch as the surface supply of the latter town is greatly in need of similar treatment (mechanical filtration) and the conditions here are nearly identical with those at Exeter. (See report of Professor Fletcher elsewhere.)

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As this system is under the special charge and control of the engineer who constructed the plant, the matter did not come to the attention of this department, so that the nature of the trouble can only be surmised.

While Exeter is somewhat handicapped in having an inferior source of supply—the latter inclining to decided clayeyness, or "muddiness"—yet with the excellent filtration plant, there is no reason why, with proper operation, water of perfectly good quality should not be turned out.

It is obvious that the filtered water at the time of the trouble carried a considerable proportion of suspended material, representing either iron or vegetable mater. If the latter, such could have come in only from the pond, as a result of faulty filtration. Any considerable amount of suspended iron would be attributable to rusting of the mains.

Records at the pumping station show that at the present time the coagulant is applied at a rate as high as nearly three grains per gallon.* This is a relatively high rate—higher than the natural alkalinity of the water could at all times care for. As such alkalinity is not artificially reinforced, and as the latter is liable to drop very materially coincident with heavy rains—at the very times when the use of a larger proportion of the coagulative agent is imperative in order to insure perfect clarification—it is apparent that unless the treatment is very carefully adjusted and constantly watched, undecomposed alum will pass into the filtered water, a condition favorable to rusting of the mains in time, to say nothing of other objections to such an occurrence. To guard against this, it is very desirable that the engineer in charge of the pumping station be required to make periodic tests of the filtered water. The test for undecomposed alum is not complicated and can be carried out by any intelligent person.

The State Laboratory of Hygiene should also take steps to secure information as to the efficiency of operation of this filter.

BOSTON, MASS., August 18, 1913.

Dr. Irving A. Watson, Secretary
State Board of Health,
Concord, N. H.

DEAR SIR—Your letter of August 9 to Mr. C. H. Johnson, superintendent of the Exeter Water Works, has been referred to the writer, and he begs to submit the following information, which may be of value to your honorable board.

It must be obvious to you, as Mr. Howard's report intimates, that the water at Exeter is a very difficult one to treat, because it has a very low alkalinity, especially during flood seasons, considerable turbidity at times when high waves wash the shores of the reservoir, and a high color. Consequently it is extremely difficult, without the addition of soda, to supply sufficient sulphate of alumina or add coagulant enough at certain seasons of the year to remove the color, turbidity and bacteria to an adequate

*This statement is based upon some figures secured at the pumping station, it being represented that on the date in question the sulphate of alumina consumption was 125 pounds per day, while the hourly pumpage averaged about 23,000 gallons. Pumping thirteen and one half hours—the period as stated—this would be equivalent to 2.8 grains alumina per gallon.

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degree, and at the same time prevent undecomposed sulphate of alumina from passing the filters.

Since January, 1913, the plant has been under the supervision of the writer. Data is being accumulated which will enable the management to avoid the difficulties on either hand, and to maintain a safe course.

Enclosed herewith please find an analysis* sheet giving the results made in the writer's laboratory since the first of January. You will note that these results show at times both the effects of adding insufficient amounts of sulphate of alumina to remove the color, and of adding so much (April) that the water contained free sulphate of alumina.

The trouble in April, due to the addition of more coagulant than the water could decompose thus lead to a reduction in the amount of coagulant. This amount proved insufficient for the removal of the color, consequently vegetable coloring matter came from the filters in a colloidal, uncoagulated condition, and deposited in the distribution system subsequently. The difficulties mentioned in your letter, therefore, were due to the use of insufficient sulphate of alumina rather than the reverse.

The only record which we have of the passage of undecomposed sulphate of alumina into the mains was during April, 1913. Since the filters were started in 1906, there has been only one other occasion where there has been any evidence of any undecomposed coagulant reaching the distribution system.

In view of the facts, your suggestion to have the filter attendant test the alkalinity of the water daily will be adopted immediately. A simple test to determine whether the alkalinity is greater or less than ten parts per million has been devised, and instructions will be given the attendant to notify this office whenever the alkalinity of the filtered water falls below ten parts per million. The test of the alkalinity at Exeter has been thought of before, but on account of the filter attendant's lack of chemical training, was not considered feasible; the devising of a simple test will make it so.

The Exeter water requires about 2.5 grains of coagulant per gallon for one hundred parts of color per million. There have been added to the water on the average, since the first of January, the following amounts of sulphate of alumina:

AVERAGE AMOUNTS OF SULPHATE OF ALUMINA APPLIED TO THE WATER AT THE EXETER FILTERS.

Month	Ave. grains per gal.
January	2.03
February	1.69
March	1.87
April	1.91
May	1.64
June	1.69

At present about 2.20 grains per gallon are being added. There is no record of more than this being applied to the water at any time since

*Incorporated with other analytical data under "Exeter."

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January first. Amounts added during May and June were insufficient for the removal of the color, and some coloring matter passed the filters. Furthermore, no coagulant was applied to the water for a few days during May, in order to make some repairs, and some of the deposit from the pipes may be due to organic matter which passed the filters at that time.

During July the reservoir suffered greatly because of the growth of asterionella. This growth was destroyed by the addition of a small dose of copper sulphate. At the same time the coagulant was increased from about 1.7 to about 2.2 grains per gallon. You will note by comparing sample No. 2241 with No. 2323, collected before and after changing the amount of coagulant respectively, that compartively little increase in the amount of sulphate of alumina brought about a satisfactory removal of color.

It is probable that at certain seasons of the year the addition of soda may be necessary to permit the addition of sufficient sulphate of alumina to effect satisfactory purification of the water. I underestand that the company is prepared to do this. The company has also given orders for an air agitation system, so that the filter sand may be stirred during washing with jets of compressed air, and the removal of odors due to any chance growths of organisms in the reservoir be facilitated. It is expected that this new device will be ready for use this month.

One more point might be mentioned, namely: that the water at Exeter can stand an unusually large dose of sulphate of alumina, because the reduction of alkalinity per unit of coagulant is unusually low.

Yours very truly.

ROBERT SPURR WESTON.

PEMBROKE.

The 1913 session of the legislature having granted the town of Pembroke a charter to construct a system of water supply from Pleasant Pond, an investigation of facts relative to this source was made on August 19.

Pleasant Pond is situated near the northern boundary of the town of Deerfield, lying partly in this town and partly in Northwood. Hitchcock's "Geological Survey" gives the area as 490 acres. Its major axis extends very nearly north and south, the greatest length being about one and eight tenths miles, the greatest width, three fourths mile.

The pond is fed mainly by springs, there being no entering brooks of size. The shores throughout their whole extent are very clean, and it seems evident that the whole basin is overlayed by sand or gravel. A sample of the water, collected February 15, 1913, from the northern extremity through a hole in the ice, gave the following analysis, this being compared with those of two samples submitted from the Suncook Water Company's supply—one collected at about this date, the other three months later.

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	Pleasant Pond (10765)	Suncook Water Company (10771)	(11062)
Odor	v. slight	marshy	aromatic
Color	0.05	0.80	1.40
Turbidity	none	slight	none
Sediment	v. slight	none	slight
Free ammonia	0.0010	0.0010	0.0010
Albuminoid ammonia	0.0110	0.0085	high
Nitrates	0.005	0.005	0.010
Nitrites	0.0000	0.0000	0.0000
Chlorine	0.30	0.18	0.15
Hardness	0.7	0.1	0.1
Total solids	3.2	4.0	3.7
Fixed solids	1.5	2.3	1.9
Colon bacilli	negative	negative	negative

A noticeable difference in the character of the two supplies is in the very much higher color and content of organic matter in the latter source. In the case of the Pleasant Pond water the degree of color is as notable low as it is extraordinarily high in the case of the Suncook Water Company samples. It may be remarked that the proportion of nitrogenous organic matter in the one sample of Pleasant Pond water submitted is somewhat above the average. This, however, is a value that is liable to considerable fluctuation. Both sources represent exceptionally soft water.

The gently sloping water-shed of Pleasant Pond, amounting to approximately four square miles, consists largely of woodland, with relatively little cultivated land. The eastern shore is wooded throughout the entire length, with some pasturage beyond. The western shore includes more open land, the latter, however, being apparently neither very actively cultivated nor pastured to any appreciable extent. On this side there are four or five sets of farm buildings, including one "abandoned" property. From but one of these is there any possible likelihood of objectionable drainage reaching the pond; while such an occurrence would seem to be of rather remote probability, the conditions are easily controllable.

While conditions throughout the water-shed back from the pond are therefore very satisfactory, one less favorable circumstance is to be found in the nucleus of a "summer colony" already established upon the shores of a pond. Because of the sparsely settled surroundings and the isolated, rather inaccessible nature of the locality this place has evidently remained "undiscovered" for the most part until comparatively recently, and progress in cottage and camp building has not as yet attained any serious proportions.

At present there are some ten to twelve cottages located on or near the shores. A number of these were visited by me and the sanitary arrangements found to be satisfactory in every case. As the number of cottagers is liable to materially increase in the near future unless the necessary steps are taken to discourage their influx, it is desirable that regulations for the protection of the purity of the water be promulgated at an early date.

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Another view of a water supply reservoir, locally known as the "Bull-Frog's Paradise." The condition illustrated is one reason why the town is now installing a system of its own.

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Bottom of a distributing reservoir, water drawn off. No expense incurred here for removal of trees, stumps, etc., previous to flowage. (See page 185.)

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The intake will be at the northern extremity, in front of the highway, and at about two hundred feet from the shore. At this point the Suncook mills has a dam with gate for the purpose of regulating and controlling the volume of flow in Suncook River (through Suncook Pond, immediately below). The distance from this point to Suncook Village is about thirteen and three-fourths miles.

The matter of bathing in this pond is something calling for early regulation, especially as a popular place for this act is the very shallow water in the immediate vicinity of the proposed intake.

It is planned to convey the water through 12" wood stave pipe, suitably iron-bound and treated upon the outside to resist decay. With the elevation at the pond of about two hundred and fifty feet above Suncook Village, it is estimated that the water can be delivered at this point under a pressure, making due allowance for friction, of not less than one hundred pounds, thereby affording good fire protection for Pembroke Street as well as for Suncook and Allenstown.

It is understood that construction will not be commenced before next spring. Incidentally it may be mentioned that the charter under which the town will operate contains a provision requiring that the latter take over the property of the present Suncook Water Works. Upon request of the secretary of the local health board, a visit was made to this company's reservoir on the same date. A description of the latter will be found in an earlier report (S. B. of H. Report, xx, p. 142).

This supply was installed some fifteen years ago by the late Frank Jones, being subsequently taken over by a stock company. There are two sources, (a) Cold Spring Brook, a fairly satisfactory water, although rather highly colored, and (b) Bear Hill Pond, distant in a direct line southeast of the village about four miles. The latter source is said to be muddy, and the water highly colored. A small brook brings the water down to the reservoir, formed by the damming of an unstripped swamp tract. The lower end of this reservoir is underlayed by Akron pipe covered by a layer of sand and gravel, through which the water is intended to seep before entering the intake reservoir formed by constructing a second dam a few feet below the first. Into the latter chamber, known as the reservoir proper, the water of Cold Spring Brook is also pumped.

On the date in question the storage reservoir had been drawn down nearly dry and men were engaged in cleaning the sand layer near the dam. The photographs submitted herewith illustrate well the character of the impounded area. As nearly as could be learned, this filtering layer is cleaned only at long intervals; in any case, its value is no greater than that of a strainer for holding back suspended matter, and it is evident that some water goes through without even this degree of clarification.

In addition to its main pumping plant for raising brook water to the reservoir, the Company, in January, 1911, installed an emergency pump at the dam on the Suncook River. It is said, however, that this source has never been resorted to upon but one occasion—that of a fire. Although nominally maintained for fire purposes only, yet it has been pointed out that it could be of no

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value in the event of any considerable conflagration, for the reason that such a circumstance would involve the cutting off of the current by which the pump is operated. We desire to emphasize that if there is any future likelihood whatever of Suncook River water being injected into the mains pending the installation of the new supply—a circumstance which now seems to be rather improbable—this river pump should be provided with a chlorinating equipment, i. e., of some means of injecting a solution of chloride of lime into the suction pipe.

For the installation of the Pleasant Pond system, the town of Pembroke voted to issue bonds in the amount of $200,000. Various difficulties have been encountered. At the outset, the town and the existent water company failed to agree in the matter of the price to be paid for the old system, with the result that an appeal to the court became necessary, the amount of damages being finally determined by a jury. Subsequently an attempt was made to restrain the town from commencing construction, on the alleged ground that the proposed size of main would not provide adequate fire protection. Eventually these difficulties were cleared up, and at this date we are informed that substantial progress has been made in construction.

HAVERHILL.

Pursuant to a request made by Mr. A. K. Merrill, chairman of a special committee appointed to select a water supply for the precinct of Haverhill, a visit was made to that town on August 15, 1913, and in company with Mr. D. J. Winn, the proposed source examined.

This inspection was supplemented by another visit on August 25, on the evening of which date your representative also attended a meeting of the precinct, and explained certain matters relative to the quality of the proposed supply. The latter consists of springs, located on and just beyond the Morris farm, so-called, somewhat more than two miles southeast of the village.

These springs are situated a short distance below the mouth of a deep ravine leading from the top of the divide on the east. An area of three or four acres below the ravine consists of very wet soil, the run off from which is considerable. While the immediate slope is toward the west, there is also a general slope to the south, so that in the case of the first and third sources mentioned the line of drainage is not coincident with a line connecting these points of collection.

The first sample (No. 11444,) was taken from the barrel enclosing spring situated in the fork of the roads a few rods above the Morris place. Cattle are watered here daily and, as a result, present conditions are not very clean. The analysis afforded by this sample was not favorable; an excess both of organic matter, nitrates and chloride being indicated.

August 18 another sample (No. 11451) was taken by Mr. Winn from a small basin scooped out in the ravine at a point about fifteen rods above the roadside spring. The results were even more unfavorable than in the first case. Accordingly, on August 19, two more samples were collected, No. 11463

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being from a spring located a few rods below the first source examined, while No. 11464 was taken from the outlet of a "blind" drain in the open field still farther down the slope. From the source of No. 11463 a pipe conveys water to the Morris farm buildings.

Both the latter samples proved to represent water of excellent character in all respects except for being a trifle harder than the average. Although issuing from open mowing land, there was no evidence of any contamination. The content of chlorine was found to be practically normal, while that of nitrates was even below normal for pure water, being practically nil in each case. The soil seems to be a clayey loam, and it is rather doubtful if the degree of hardness is attributable to any great extent to cultivation, although it is impossible that by future non-fertilization of the tract in question, the hardness would eventually become somewhat diminished. It should also be borne in mind that the degree of mineralization is at its maximum at this period.

It has been generally supposed that all this water is from the same "vein" and that it comes originally from Lake Tarleton. Careful examination shows that there is a natural divide, slight but distinct, extending diagonally across the general slope and separating the first two springs sampled, from the last two. While this would serve to explain the difference in character observed between the two groups of springs, i. e., that they are totally different waters, yet another explanation is in the probability that the ground water flow is not through a single "vein" but is represented by a sheet of considerable area, and that in the first two instances the contamination noted, local in character, is confined to a relatively small portion of the total water sheet, such portion being deflected to the south of the main flow by the divide mentioned.

With the exception of one farm, situated for the most part to the south of the ravine mentioned, there are no farm buildings and no arable land above this spring tract. In case of the one barn, the drainage is altogether into another watershed to the south. It is stated, however, that in recent years quite a number of carcasses of cattle have been deposited in the ravine above the first springs sampled, and this fact serves as about the only apparent explanation of the high nitrate content noted. If this is their origin, such a situation is of course but temporary in character, and it would appear evident that in the event of the precinct eventually wishing to extend its source of supply—an improbable circumstance—not only could these first mentioned springs be readily utilized, but a dam could easily be constructed across the deep gorge just above, the resulting reservoir serving most admirably as storage for emergency, although subject to a certain amount of field drainage from the farm referred to.

It is planned to conduct the water to a covered concrete reservoir, to be constructed at a point a little less than a half mile nearer the village and at eighty feet lower elevation than the springs. This reservoir will be 60′x25′x13′ deep, with a capacity of slightly less than 150,000 gallons. The elevation is sufficient for ample fire protection. While no figures were available as to the definite amount which these springs will supply, yet it is claimed by the engineer who made the survey that there will be an abundance.

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The situation therefore may be summarized by stating that the Morris springs would provide a supply of excellent quality as regards organic purity, safe and satisfactory in all respects with the possible exception of hardness, the latter being above the average for our New Hampshire supplies, although not prohibitive in degree. This feature as well as others bearing upon the quality was carefully explained by me at the precinct meeting. At this meeting, on August 25, the precinct voted to purchase this supply and to issue bonds therefor in a sum not exceeding $20,000, such action being conditioned upon securing the approval of the State Board of Health of the source in question.

It may be stated that but one other source was considered, this having previously been rejected by the committee from both sanitary and engineering considerations.

The analytical data obtained on the four samples from the Morris location is appended herewith.

*Analyses of samples collected from springs on the Morris location.

No. 11444 collected August 15 from barrel over spring by roadside.

No. 11451 collected August 18 in ravine about 15 rods above source of 11444.

No. 11463 collected from spring in Morris field a few rods below No. 11444.

No. 11464 collected from outlet of "blind" ditch in Morris field.

	No. 11444	No. 11451	No. 11463	No. 11464
Odor	dist. earthy	dist. earthy	None	None
Color	0.05	0.03	0.00	0.00
Turbidity	v. slight	sl. earthy	None	None
Sediment	slight	sl. earthy	None	v. sl. flocc.
Free ammonia	.0022	.0054	.0012	.0004
Albuminoid ammonia	.0060	.0058	.0016	.0012
Nitrates	.075	.125	.004	.002
Nitrites	.000	.000	.000	.000
Chlorine	.30	.25	.14	.11
Solids	.....	12.5	9.2	10.0
Hardness	6.9	7.1	6.0	5.3
Iron	.....	0.03	0.01	0.01
Colon bacilli	Doubtful	Negative	Negative	Negative

MERIDEN.

On September 10th, Mr. C. A. Tracy forwarded a sample of water taken from a spring under consideration as an additional source of supply for the village of Meriden. The analysis of this sample proving not quite satisfactory in certain respects, also in view of the law relative to inspection of new sources of supply, I went to Meriden on September 17th and made an examination both of the present and proposed sources of supply.

The present system of the Meriden Water Company includes two reservoirs located in pasture land slightly more than a mile northwest from the village.

*See also No. 10930 collected April, 1913, from tap on present Haverhill Aqueduct Company System.

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The lower and larger reservoir, which is absolutely dry at the present date, consists merely of an uncovered and unwalled excavation situated but a few feet from the highway. This elevation is said to be about fifty feet above Richards Hall, original capacity (now materially reduced by sliding in of the walls) estimated at about 15,000 gallons. This reservoir is fed by a spring in the bottom, also by a well located in the rear of some farm buildings near by. It undoubtedly receives a considerable amount of surface wash from the pasture slope above, and as it was apparently originally only an emergency affair, affording water of indifferent quality, it should be abandoned following installation of the new source.

The other reservoir, the original one of the system, is situated at about fifty feet higher elevation, and is covered and well constructed from granite and cement. At the present time the tiny stream trickling in from the half dozen nearby wells that feed this reservoir hardly amounts to more than a gallon a minute. In short, the total amount of water available from the whole system is scarcely enough to operate the flush closets in the village, and water for drinking purposes at the Academy is now being carried from private sources.

The community of Kimball-Union Academy, numbering about 200 persons, is the principal consumer. The total population served is probably not over three hundred persons, and the total daily consumption is estimated at about ten thousand gallons.

Subsequent to shipping the sample referred to it was decided to proceed further away and take the water of a brook flowing out of Corbin Park. The present proposed point of intake is one-half mile below the Park fence, is one mile from the Academy, and with the elevation above the latter of about fifty feet, will afford a gravity pressure satisfactory for general domestic use, although unfortunately insufficient for fire protection. By going further back on the stream, however, the pressure might be considerably augmented; incidentally it may be suggested that the economy in constructing a main as small as 2″ (galvanized iron) is open to question.

The water-shed of this brook is wholly wooded and there is no pasturage—at least of farm animals. The fact that roaming over the 15,000 acres constituting Corbin Park there are some 300 wild boar as well as about 75 buffalo, may be taken into consideration, although it seems doubtful if this is likely to prove any serious source of pollution. The fact that the analysis of the sample taken at this time of low water, when the animals would be most likely to impart contamination, is entirely satisfactory both chemically and bacterially, is confirmative of the above view. Notwithstanding that there has been no rain of any consequence in this section for a very long period, the flow of the brook at this time is considerable and will afford a supply abundant for the needs of the village.

The brook bed is gravelly and clean, and the water very clear and attractive in appearance. A sample collected at this date afforded results as follows:

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Odor	none
Color	0.05
Turbidity	none
Sediment	v. slight
Free ammonia	0.0002
Albuminoid ammonia	0.0050
Nitrogen as nitrates	0.001
Nitrogen as nitrites	0.0000
Chlorine	0.07
Total solids	3.5
Fixed solids	2.3
Hardness	1.6
B. coli	negative

While the water is not biologically objectionable there is some growth of algae identified as ulothrix noticeable on the rocks in places. This, however, will scarcely affect the quality of the water. As a surface water, the above indicates unusual excellence in the low degree of color and organic matter. In fact, it will compare very well indeed with the spring water constituting the original source of supply, and in my opinion it is better than that afforded by the present lower reservoir.

CHARLESTOWN.

On October 21, 1913, in company of two members of the Board of Water Commissioners, an examination was made of conditions on the water-shed of the Charlestown village water supply.

The source consists of a small brook on which two reservoirs are situated at a distance of about three miles north of the village. The lower reservoir is small (about one third acre), and at the present time the feeding brook amounts to but a mere trickle, such brook in fact disappearing altogether a short distance above. The main reservoir is located about a half mile further up and includes an acre or more. The shores of this reservoir have recently been cleared, and I found conditions clean and satisfactory.

The brook which feeds the main reservoir is not more than eighteen inches across, and on the date in question was probably discharging less than twenty-five gallons per minute. The conditions on the lower end of this brook are bad. Just above the point where it discharges into the reservoir is a set of farm buildings. A henyard runs down to and includes the brook, the slope being about forty-five degrees, with henhouse about seventy-five feet from the water; loose soil. Immediately back of the henhouse and also sloping toward the brook are two pigpens, while overhead there was in process of construction a tie-up for cattle, the intention being to discharge the manure from the latter into the pens. Adjoining the latter is also a privy—all on a slope toward the brook, and at a distance of not more than one hundred and twenty-five feet therefrom.

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A few rods above this place a second cause for complaint was noted in connection with another set of farm buildings. This consisted of a pigpen situated immediately on a small brook tributary to the water supply and not more than seventy-five feet therefrom. Though dry at the time, this water course must carry considerable wash into the main brook during rains or wet periods. At such times, there is also chance for manure drainage from a nearby barn, the location of which slopes sharply toward the hogpen brook.

Still further above, the main brook flows through pasture land which affords grazing for over one hundred head of cattle. The latter use the brook as a drinking supply, and there is nothing to prevent their wallowing in it.

Bearing in mind the small size of the brook, it will be appreciated that during rainy periods an appreciable amount of contaminative wash must necessarily enter; while the fact that cattle have access to it introduces an additional factor of pollution—and a most objectionable one at times when the brook is very low. Examination of samples collected in this neighborhood a few days later, during rainy weather, serves to confirm the correctness of this view, although the latter is sufficiently apparent without any analysis.

As a remedy, no satisfactory alternative can be seen but the purchase by the town of the set of farm buildings first mentioned. At the second farm, the owner can undoubtedly be compelled to remove the hogpen and take care of the barnyard drainage, upon due notice. With regard to the pasturage—the least serious feature at present—it should be feasible for the town to purchase a few rods area on either side of the brook and furnish the owner with a substitute water supply for his cattle.

BELMONT.

Complaint was made to the State Board of Health that a certain party was depositing logs near the brook from which the water supply of Belmont is taken, and that it was the intention to establish a sawmill there to cut a large amount of lumber, and a request was made that action be taken to prevent the proposed work, as it must necessarily endanger the water supply.

In order to determine the exact situation, the chemist of the board was requested to visit the locality, which he did, and rendered the following report:

On January 30, 1914, an investigation was made of the circumstances involved in the deposit of a lot of logs on the bank of a small stream used in part as the source of supply for the town. It is the intention of the party concerned in this case to haul to this site a total of about 200,000 feet and here to saw these logs into lumber durign the coming spring.

These logs are deposited on a semi-peninsula formed by a sharp bend in the brook, on land sloping from thirty to forty degrees. Many of the

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logs are quite close to the brook, less than 100 feet. Between the slope and the brook, there is a strip of intervale varying from 20 to 50 feet in width. It is now proposed to erect the sawmill at a point on the slope near an apple tree, probably 150 feet from the brook at its nearest point, such point being some 200-300 feet above the present intake. It is claimed that the sawdust will all be removed within a year's time, and that precautions would be taken to prevent such getting into the brook. At the present moment there are said to be about 100,000 feet of timber on the spot in question, which is practically within the village limits. The owner's farm, with buildings, are but a few hundred feet away—just across the brook.

Water from the latter is pumped to a reservoir about a mile distant, the supply being supplemented by wells. The engineer informs me that the pump, which has a working capacity of 55,000 gallons per minute, is operated from two to four hours per day—not every day of the year but on the majority of such. While there are, unfortunately, no pumping records, yet from all the testimony it is clear that this brook forms a considerable and rather constant part of the general supply and that it is an important part thereof, although this point the affected party disputes.

From a consideration of all the circumstances, I am of the opinion that the operation of sawing up the lumber on the plot in question, together with all that is involved, would endanger the quality of the water supply. The reasons for this view are sufficiently apparent and have, in fact, already been discussed orally with you.

The party who was proposing to go into the lumbering operations as described above, appeared at the office of the State Board of Health for a hearing in the matter. After discussing the entire subject, he agreed to remove the logs to an unobjectionable locality, and to abandon entirely the idea of establishing a mill upon the banks of the brook, as was at first contemplated.

A second report was subsequently made by Mr. Howard, as follows, with recommendations for the protection of the said water supply:

In connection with a partial inspection of the supply of the Belmont Water Works, made January 30, 1911, the following facts appeared:

The original, and possibly today the larger part of the supply, is derived from wells. There is, however, a brook flowing in a northwesterly direction, and situated rather closely at the intake to one of the residence streets, from which an important share of this supply is derived. The pumping station is located on one of the village streets. Pumping is at the rate of 55,000 gallons per minute, to a reservoir about one mile distant, and it appears that this source is in use rather constantly throughout the year.

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The brook, which is some six or eight feet wide, flows between steep slopes of open grass land. On the west side there are two sets of farm buildings, drainage from which is liable at times to enter the brook above the intake. In addition there is also said to be a twelve-inch culvert which carries excess water across the street into the brook above the intake, such water representing ordinary cultivated field drainage, although there is a likelihood that more or less filtered barn drainage from one of the farms also gets in.

On the other side of the brook and but a short distance therefrom up a moderately steep slope runs one of the village streets. Here are one or two barns and three or four residences, the situation being such that there is liability, especially at certain times, of sewage reaching the brook from these places. The worst place noted is situated upon a very steep bank opposite a point in the brook some four or five hundred feet above the present intake. Both the privy and the cesspool are so situated, that not only does the drainage therefrom necessarily have a short and direct course into the brook, but heavy rains are at times bound to carry down wash from these places.

It is true that the analyses made from time to time of this water (it does not appear that we have had many samples direct from the brook) have not shown any positive evidence of contamination since 1908. Prior to that time, however, the records do show five instances when sewage bacteria were found to be present, although it is not clear whether brook water was a constituent of all the samples so involved. However, this may have been, the fact that the water may have proved good analytically on some given date, should not be permitted to outweigh the existence of unsanitary conditions, involving serious liability of contamination of the supply at some times, even though perhaps not at all times.

In my opinion, the town should take early action toward extending its intake pipe up the brook to a point well above any danger of serious contamination. As the necessary distance would be inconsiderable, this would involve no very great item of expense.

It was suggested in a communication to the Board of Selectmen of the town that an article be inserted in the warrant for the town meeting for an appropriation and authority to extend the intake pipe to a point beyond all danger of pollution.

FRANKLIN.

The following record of facts in regard to the recent installation of an emergency hypochlorite outfit for water treatment at Franklin is submitted:

Owing to a shortage in the regular supply, application was verbally made for permission to augment the latter by direct pumpage from the Pemigewasset River, also for the use of an emergency outfit as described on page 61 of the July-October, 1913, Bulletin.

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Accordingly I went to Franklin on February 14 for the purpose of determining conditions, and on the 17th returned and installed the outfit, the latter having been forwarded in the meantime.

The normal supply is derived from two sources (a) a group of springs and wells commonly referred to as the Coldbrook Springs, affording a daily yield of 60,000 to 100,000 gallons, and (b) a combination of tubular well water and of filtered Pemigewasset River water accumulated in such wells and pumped to what is known as the No. 2 reservoir. From the latter it flows by gravity to the main (Bow St.) pumping station, where it mingles with the Coldbrook Springs water and is thence pumped to the No. 1, or distributing reservoir. It is claimed there are no services attached to the filtered river system prior to reaching the Bow St. station. Pumpage at this place is by water power and is continuous for the twenty-four hours. Normally, the daily amount pumped is said to vary between 150,000 and 200,000 gallons, but at this time, on account of the severely cold weather, the pumping record for the week ending February 14 had shown a range of from 240,000 to about 300,000 gallons.

Recent analyses of Pemigewasset water do not indicate any condition of gross contamination at the point of intake. The chief point at which sewage enters is at Plymouth, some twenty-four miles above. While no detailed survey has as yet been made, it seems improbable that any great amount of sewage is discharged below this point. The chemical analysis of a sample of the raw water collected February 12 shows it to compare very favorably with the average surface water supply in general character. No reaction for coli was afforded by a 1cc test, but the 10cc test was positive. Samples for bacteriological examination subsequently collected have shown a remarkably low bacterial content. It seems rather probable that such must be abnormal findings, due to the extremely cold weather then existing. These river samples afforded positive results for colon bacilli on the 10cc test, those using 1cc being "doubtful."

It is learned that it is not the custom to clean the filter at all during the cold season. Consequently, the embarrassment incident to freezing weather and ice accumulation encountered in the case of the average supply in this latitude using an open filter is not met with here. Nevertheless it seems quite possible that failure to afford the normal amount of effluent at this period may be due in part at least to a stiffening up of the sand bed. The reason that cleaning is not necessary except at infrequent intervals at this plant is due in part to the fact that a comparatively large filtering area is available for the volume of water filtered, the rate per acre per day being exceptionally low; (b) to the fact that a settling basin of generous proportions allows of a preliminary removal of most of the sediment and much of the bacteria. A third reason is in the fact that the raw source is much cleaner than is true, for example, in the case of the Somersworth supply.

While the logical point at which to establish a sterilization treatment would of course be at the river station, yet because of the somewhat crowded condition of the latter, it was agreed that the outfit might be installed, temporarily at least, at the main station, thus sterilizing the

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whole of the supply. The only objectionable feature in this location was in the fact that it involved the collection of raw river water in the small storage reservoir, and to obviate this difficulty it was directed that the treatment be continued for two days following cessation of river pumping.

Previous examination of two samples of Acme Chloride of Lime (A. Mendleson's Sons) showed a net weight per can of slightly less than 12 ounces, with a chlorine strength of approximately 33 1/3 per cent. It being determined that a treatment of .25 to .30 parts chlorine per million would be sufficient, it was accordingly directed that the contents of two and one half cans be dissolved in the fifty gallons of water and delivered into the pump well at the rate of two gallons per hour during the twenty-four hours' run. From the results on the single set of samples thus far examined, it would appear that this treatment is sufficient.

Subsequently this office has been advised that it has been decided to find a place for the sterilizing equipment at the river station. As here the pumpage is triple the hourly rate at the Bow St. station (500 gallons per minute), and the daily period but one third, it was directed that the same solution be continued, delivering into the suction pipe at the rate of six gallons per hour. It is anticipated that direct river pumpage will not be necessary after the cessation of cold weather, and at present it is not demanded continuously.

PLYMOUTH WATER SUPPLY.

The town of Plymouth having decided to make an extension of its water supply system, the situation was examined on April 6, 1914, the following facts being ascertained:

The main system has its source in twenty-seven shallow wells draining into two reservoirs located about two miles west of the village at such elevation that a pressure of approximately eighty-five pounds is afforded.

These wells, which are located in woodland, vary from six to ten feet in depth, and are brick-lined and provided with stout wooden covers. From the bottoms of them the water is piped into an open channel which conducts into the reservoirs.

While it is represented that this channel is cleaned from decaying leaves, etc., once each year, yet it is apparent that with the present system of tree cultivation close to the ditch, considerable material must fall therein which adds to the color and organic content of the supply somewhat. Also, during the melting of the snow in the spring, a certain amount of objectionable matter is carried into the reservoir in this way.

While the ideal arrangement would involve the piping of this water into the reservoir, yet the open channel doubtless serves the purpose fairly well as it is, although it would be an improvement to cut back the growth on either bank a few feet—just sufficient to reduce somewhat the contamination from dropping leaves and twigs, yet without unduly exposing the brook flow to evaporation through too great admission of sunlight.

The superintendent, Mr. Fogg, states that it is his practice to draw down and clean the bottoms and sides of these reservoirs in alternate

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years. The latter are well constructed, with rubble walls. The estimated capacity of each is about two million gallons, a volume greater than is apparent from casual observation.

The present well system, however, fails to supply sufficient water, even with the storage available, for warm weather needs, and about two years ago an auxiliary supply was added, consisting of six wells excavated on an intervale lying between the Pemigewasset and Baker Rivers at a point a short distance above their confluence and about a half mile north of the center of the village.

The one-acre tract on which these wells are located and which represents all of the intervale that is owned by the town, is situated a few feet to the east of a terraced bank, on the edge of which are the Foster peg mill and a row of four tenements, the latter being provided with earth closets and all being within about 150 feet of the wells. There are no buildings and no cultivated land on this intervale. The wells are about six feet square and eight to twelve feet in depth, being covered with about three feet of soil. The latter is of very loose, porous character, consisting of a reddish gravel, overlaid by a black muck-like surface stratum, and there is a belief that the whole intervale is saturated with water from the Pemigewasset River, this belief being based upon the assertion that the level of the water in the wells tends to rise and fall with that in the river. It seems quite possible that there may be some penetration of the ground water current from river to river and that such current is considerably influenced by the latter. However, the distance from the wells to the rivers is several hundred feet in either case, and any water seeping therefrom would be well filtered.

Both systems having failed to supply the volume of water needed, the present proposition is to sink some additional wells in the intervale tract. It should be stated that in this auxiliary system, which is said to afford about 75,000 gallons daily, the water is pumped directly into the mains against the gravity pressure by a pump owned by the town, but operated by the peg mill, such counter pressure being sufficient to carry the well water up into the reservoirs.

To such extension two possible objections may be considered. First. That at times of high water, this whole intervale, including the well tract, is liable to overflow. Such overflow occurred during the spring following construction, and at that time resulted in the caving in of the earth covers of two or three of the wells. The tract was again overflowed during April of this present season, following my visit. The chance of contamination is in the fact that considerable sewage, mainly, however, industrial in character (pulp waste) is discharged into the Pemigewasset River at points above. There is, however, no reason why a substantial covering could not be constructed for these wells so as to prevent any direct inflow of water at such times.

Our examination of two samples of this water, drawn April 28, a few days after flooding, indicated in a general way water of excellent quality. It is true that the first sample drawn from the pump did afford a positive color reaction on a 10cc. test (not on 1cc), but it is not con-

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sidered that this of itself should be regarded as a factor of serious significance. The second sample, collected after about an hour's pumping, was negative on both 1cc. and 10cc. tests. The water was entirely without color, clear, with but little if any odor, and with a minimum of organic matter.

But even assuming that flooding of the intervale does constitute a menace to the quality of this well water, it should be noted that this source is used only during the summer season, when high water does not occur.

The second possible source of contamination is from the peg mill itself and the contiguous tenements. It was noted that a continuous trickle of water, representing condensed steam and oil-impregnated boiler waste, issues from the bank above and subsequently seeps with noticeable abruptness directly into the ground from a small pool which forms within fifty feet of the nearest well. It is stated that every two or three days this waste discharge is very greatly augmented through the sudden drawing off of five or six thousand gallons of water representing the contents of a tank in which the birch logs are given a soaking treatment. It is true that the chief contamination of such water consists of fibers and resinous matter washed out of the wood; yet the abrupt discharge of such a large volume of water in the immediate neighborhood of the wells, where it must necessarily at once penetrate to the ground water level, is objectionable.

In conclusion, while the conditions immediately adjoining the present well tract on the intervale are far from ideal, yet past analyses have indicated that these wells are affording water of a very satisfactory character, and the quantity available in this way seems to be susceptible to material further increase. In view, therefore, of the character of this water, I am reluctant to make any recommendation amounting to condemnation of this site as a source of further supply, justified though such a recommendation possibly might be on the basis of the local conditions.

If the town particularly desires to extend its supply from this source, it is believed there need be no objection, if the condition be made that the discharge of waste from the peg mill be discontinued from its present course and be carried off in a reverse direction toward the Baker River—something which appears to be entirely feasible to carry out.

There should also be a strict supervision on the part of the health officer over the waste disposal from the tenements, i. e., the closet receptacles should be of tight construction and be kept properly cleaned; also the sink drainage might very properly be conducted into the rearranged mill sewer, as above prescribed.

It would, further, be well for the town to purchase more of the intervale tract, with a view to constructing the new wells further to the east of the mill property.

Yet, while sanctioning the proposal to extend the present water system in this way, I desire to emphasize the opinion that the best and most logical course would be in seeking to secure the necessary increase at the main source. Not only would this obviate the expense of pumping, but it would afford a supply entirely free from the stigma which necessarily

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is inseparable from a source where the surroundings are of the character true of the lower system. It is quite possible that sufficient further extension of the main well system would involve considerable new construction, yet in considering the expense not only of this but of piping some one and one half miles a mountain brook source said to be available at this distance, the off-setting cost of daily pumping in the case of the lower well system should not be forgotten.

NEWMARKET.

HANOVER, N. H., July 4, 1913.

MR. GEO. H. WILLEY,
Chairman, Board of Water Commissioners,
Newmarket, N. H.:

DEAR SIR—As a result of my visit on July 2d-3d, personal inspections, conferences with members of your Board, with the Board meeting of July 2, and with your Superintendent, Mr. Harvey, I submit the following report:

Your chief source of supply, Follet's brook, is a small, shallow stream, in a narrow basin 2 to 2½ miles long, with only slope enough to give a gentle flow to the water. This area of possibly one to two square miles abounds in springs which give the saving quality to the water. Unfortunately, since you hold only water rights and have control of only a very little land, you have to submit to all of the bad results from the pasturing of cattle along the brook. The gains which you might make by cleaning out, curbing, covering, and developing the springs, and piping from one to another, would not be worth the cost if land owners maintain the right of pasturage.

Your pumping station, on Piscassic river, near where Follet's brook enters it, is operated partly by steam power (a *single* Knowles pump with no reserve), and partly by water power furnished by a dam in the river, giving about 14 ft. head. This dam, which pounds the river back about a mile to the next bridge, gives you the only storage available in times when the brook fails. Your daily pumpage now exceeds 250,000 gallons to serve about 2,500 consumers, one of which is the B. & M. Railroad Co., which buys from you 100,000 gallons daily for their station at Rockingham Junction. Hence your other consumers are drawing 50 to 60 gallons per person per day.

In spring and in winter after heavy rain, your long, shallow brook basin is flooded over a wide extent, but you have no dam to hold this surplus in storage. By mere inspection the site appears to be unfavorable for a reservoir, because a comparatively long dam would be needed and the stored water would not be deep enough for satisfactory results. This statement is not *positively* made, however, but should be proved by an actual survey. If such storage be feasible, the water would not be satisfactory until after the two or more years needed to dissolve the vegetable matter in the soil.

The conditions along the *pounded river* for about a mile above your dam are said to be more favorable than along the brook. There is less pasturage; the banks are generally protected by trees and thickets. Just now, in the drouth, there is little or nothing coming over the dam above, but considerable flow is maintained by springs in the land which drains into it. Chief among

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these is the remarkable *Chapman's spring. I am told that the flow from this is undiminished through the year; by measure and estimate it is believed to be 50,000 to 60,000 gallons daily. Of course this affects quite favorably the water stored in your millpond.

It is reported, further, that the conditions along the Piscassic river above the next dam are not good; that the flow is through low, boggy land; that there are dwellings along the banks, and that the washings of fine clay from the brickyards in Epping make the water murky. However, your millpond is a sedimentation basin a mile or more long, and gives whatever benefit results from that process (sedimentation), always of considerable efficacy as a means of purification. Your so-called "filter-bed" just above the pump-well is not a *filter,* but, as your Superintendent remarked, only a *strainer.* It does not intercept any very fine particles suspended in the water, but only coarser matter. The sides of the basin and channel seemed to be fairly clean and well kept, and the operation as good as you can expect, but no one must allow himself to think that the water is being *filtered,* as we understand that process.

The question of *ground* water is important in your case. You have testified to the success of some of you in putting down driven pipe wells, fifty to one hundred feet and more deep. One of these *flows* enough to fill a ¾ inch pipe (*by report*); another requires a lift of only ten feet; Mr. Harvey, your Superintendent, has one; but these are in another basin. The structure of your county seems to be rocky points, low hills and ridges, with hollows filled by drift, such as rocks, earth, gravel and fine sand. The boring made by Mr. Harvey some distance above your strainer-basin, procured a column in the tube rising two feet above ground level, although there was so much fine sand that the drill-point became clogged. Had a casing tube been used more success might have resulted. Expert borings and pumping are needed to show whether there is a reservoir of underground water extensive enough for your needs.

Your daily demand of 212,000 gallons to fill the standpipe and about 30% more for additional use, is a little less than one "acre-foot"—or what would cover an acre one foot deep. (280,000 gallons=40,000 cubic feet, and one acre-foot=43,560 cubic feet.) Now, if there were 5 per cent of voids in the ground, then 20 feet in depth over *one* acre would hold one acre-foot of water; but an *average* depth of 20 feet of such porous drift over any very wide area is hardly to be expected from surface indications. Yet it would be worth while to explore, at the expense of several hundred dollars, on the chance of finding such a subterraneous reservoir. It would be well, however, to seek first the advice of a man quite familiar with your local geology. You might find a large additional supply, but if not, it is better to be sure than to be harrassed by doubts.

Giving due weight to these facts, we are led to the following conclusions and recommendations:

First. You are operating under conditions not only unsatisfactory but sometimes dangerous. The *quality* of the water is always under suspicion, and the possibility of typhoid or other infection is not remote, especially when you have to pump from Piscassis river. But the laws of the state give you a large

*See analysis in tabulated data under Newmarket.

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measure of protection when duly enforced by the local board of health within their jurisdiction, and, beyond that, by the State Board of Health. Hence,

First Recommendation: The owners of all dwellings from which the drainage flows into or toward the river should be required to put in sewage tanks or free-flowing cesspools, under advice of the State Board of Health as given in N. H. Sanitary Bulletin for October, 1912, which may be had on application to the Secretary in Concord. The cost of a small tank for a family need not exceed $15.00 cash, if the owner can do the labor himself. Furthermore, the pond between the dams should be cleaned by removing all dead wood and other material liable to taint the water. Beyond your jurisdiction up the river, the State Board should be called upon to have its inspector make a thorough examination and require abatement of any nuisance or other condition liable to injure your water supply.

As to Follet's brook, our inspection on the 2d instant showed that it is now well looked after, and that its margins are as clean and the appearance of the stream as good as possible under the degrees of control which you possess. If this is to be your chief source of supply for a long time to come, a much wider control of the territory, by ownership or otherwise, should be secured and the springs more completely developed.

Thus far no action calling for large increase of expense has been suggested. Still, considering the question of *quality*, we come naturally to my

Second Recommendation, which is in brief* *mechanical filtration* of the water. This has been so universally successful that no argument is needed in its favor. A small building would suffice for the plant, since, at the allowed rate of 100 million gallons per acre per day, you would need only three or four small units. This of course would add to the running expenses of your works and call for a considerable increase in the rates. Also where waste of water is allowed or persisted in, the cost of such waste would be a serious item and the sinner should be made to pay it. From an exact estimate of cost you must apply to one who is familiar with the construction and operation of such works, to select the site near the pumping station and make survey and design. Such an addition to your works would give you water that would be unobjectionable to the most critical persons, and would conform to sanitary standards. We may say about the cost in general that the rapid filter plant, under very ordinary conditions such as yours, would cost from $8,000 to $10,000 per million gallons capacity. As you would provide for half a million gallons daily, the cost would be about $4,000, or a little more. Extensive tests and experience have shown that the cost of operation per million gallons, including fixed charges, has been from $10 to $12, which for you would mean about $5.00 per day.

But the main point of your present inquiry, as I understand it, is: How can we get more water? This brings us to the question of *quantity*, already referred to.

Second, lack of storage. Is it possible to provide *storage* for some of the superabundant flow in the spring and fall of the year? As before said, conditions for impounding by a dam do not appear to be favorable, but a careful survey might develop a fairly good site. The necessary purchase of land, clearing

*In this connection see report elsewhere on Exeter supply.

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of site and building earth dam and gatehouse would probably cost from $15,000 to $20,000.

The cost to the Hanover Water Works Co. for a much larger reservoir than you would have was $22,500, including all land damage and accessory work. To be satisfactory such reservoir should have an average depth of 9 to 10 ft., and depth of 15 ft. behind the dam. The one we built at Enfield ten years ago covers 20 acres, and is not quite so deep as I have just stated. The dam was over 600 feet long. The entire cost somewhat exceeded $15,000. For you this question could not be decided without exact knowledge of the site, maximum demand, minimum rainfall, study of loss by evaporation, etc. On the whole, we must conclude that the cost of storage on the brook would add more than 20 per cent to your capital and fixed charges and that you cannot decide that question definitely with your present knowledge.

In view of the additional fact that a movement is on foot for building a great aqueduct from Merrymeeting Pond to serve the cities and towns of the east part of the state to Portsmouth, I am led to a

Third Recommendation, to adopt a waiting policy as to any extensive enlargement of the works. You can use all possible endeavors to protect the purity of your supply by means already suggested; depend upon the storage in Piscassis river for emergencies, and, if necessary resort to mechanical or "rapid" filtration at cost of a few thousand dollars.

This report is sent to you through the office of the State Board of Health, inviting further suggestion from the Secretary and State Chemist if they have any.

Respectfully submitted,

[Signed] ROBERT FLETCHER,
Civil Engineer,
President and Engineer of Hanover Water Works Co.

NEWMARKET—DRILLED WELLS.

Conditions in connection with a recently drilled well at Newmarket were observed May 20, 1914.

As noted in a previous report (Rep. S. B. of H., 1909-10, p. 234) the main source of the town supply is Follet's Brook, a small stream flowing much of the way through open level pasture land. Previous to collection at the intake basin this water is subjected to a certain degree of "filtration" by passing through gravel overlaying a number of courses of drain tile resting in the bed of the brook. The water finally also passes through a small sand bed, it being claimed that the surfaces of both this and the gravel are scraped once each year.

Such an arrangement, however, can have no dependable bacterial efficiency; and even as a strainer, while undoubtedly helpful in keeping down the clayey turbidity, yet a certain degree of the latter is generally in evidence in the water as drawn from the service pipes.

About a year and a half ago a system of sewerage was constructed for this village, since which time the average daily water consumption has increased to approximately 200,000 gallons. At times the volume available from the brook is

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insufficient and it becomes necessary to resort to direct pumpage from the Piscassett River. The latter was the case during sixty days of last year.

The present well construction is with a view to augmenting the main supply to such extent that river pumping will be unnecessary. The first well was constructed about two rods from the brook at a point a short distance above the collecting basin and possibly a quarter of a mile west from the pumping station. The location is on a site of about ten acres of gently sloping grass land recently purchased by the town.

The drilling was done by the ——— Artesian Well Company, the cost being stated as six dollars per foot. The total depth of this first well is 238 feet, as follows; 34 ft.-6" clay, 9 ft.-6" gravel, 8 ft. boulder and hardpan, final 186 ft. through solid ledge. The casing is ten-inch to the ledge, thence eight-inch. At the time of my visit the well was flowing a stream said to amount to about ten gallons per minute according to measurements. A pumping test was stated as having resulted in demonstrating a yield of 75,000 gallons in twelve hours, a volume which is considered by the driller as susceptible to some increase when an adequate pump shall have been installed. It is the purpose to sink two other wells upon this plot if the chemical character of the water is satisfactory.

The recently collected sample of this water as viewed in the gallon bottle shows a slight milkiness, which latter seems to increase somewhat as a result of standing for a few hours, such being then designated as "marked." This turbidity is due to very finely divided clay or rock particles and will undoubtedly materially subside as the water comes into use. Sedimentation very slight as a result of standing in the sample bottle for three days.

The water shows no appreciable odor, and there is no pronounced taste. However, with careful observation, a very slight alkaline taste, faintly suggestive of lime-water, can be detected. The analysis shows no organic matter, practically no iron, and a degree of hardness to soap no greater than the average for the brook supply. A characteristic feature of this water is its alkalinity. Although the total solids content is not excessive, being no greater than is frequently encountered in the case of deep wells in this section, yet the degree of alkalinity is worthy of remark, being unusual for this vicinity although very commonly met with in much greater degree in well borings outside of New England. Thus the total alkalinity in this case, computed on the basis of normal lime carbonate, is 8.2 parts per 100,000; after deducting the alkalinity due to the usual earthy carbonates normally found in waters everywhere, there is a residual alkalinity due to *alkaline carbonates* of 3.9 parts, calculated as normal carbonate of soda, or, as such alkalinity actually exists in the form of bicarbonate, equivalent to 6.2 parts of sodium bicarbonate ("baking soda")—an amount equivalent on the "grain" basis to 3.6 grains bicarbonate soda to the gallon.

It may be remarked that while such a degree of alkalinity is but slight and—especially considering the dilution with the brook water which will ordinarily occur—is scarcely likely to exert any deleterious effects upon the users, yet it would of course be somewhat better if it did not exist. Such a water will never deposit any "hard scale" in boilers. Although acid waters have a marked corrosive action upon boilers and carbonate of soda is one of the remedies for boiler troubles, yet it is well recognized that water carrying any large quantity of alkali is on this account itself liable to exert corrosive action. In this case, how-

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ever, the amount is so small that there is no probability of such trouble, although there may be some tendency manifested to pipe-rusting. An interesting service which such a water might prform is in naturally furnishing the alkaline salt sometimes demanded to be added to waters which are purified by the mechanical system of filtration—a system of water purification, by the way, which has been recommended to this town, and one which would greatly improve at relatively small expense the frequently very turbid water representing the Follet Brook supply.

Respectfully submitted,

CHARLES D. HOWARD,
Chemist.

MAY 26, 1914.

Since the above report was submitted, the superintendent states that a second well has been completed, 403 feet deep and yielding under pumping test 20,000 gallons daily. Construction on a third well is now underway (November, 1914). None of this well water has as yet been turned into the system.

GREENVILLE.

On April 25, 1913, a visit was made to Greenville for the purpose of conferring with members of a special committee appointed to consider the installation of a public water supply.

In the absence of any suitable surface waters, a supply from driven or drilled wells is contemplated. The present population of the village is approximately 1,500, and it is believed that about 100 families would become patrons, the committee having estimated on this basis that a maximum daily supply of 10,000 gallons would be sufficient for the purpose in view. Adequate fire protection from an independent supply pumped from the Souhegan River already exists. The drinking supply, at present derived from a 400-foot well, has proved insufficient, and further, the quality of such has lately deteriorated to such a degree that it is extremely unsatisfactory.

Three locations were examined, but in the absence of any test drillings as yet, it is impossible to venture any positive predictions as to either quality or quantity, as regards the supply available. One location is on the flat near the railroad station. A spring at the further end of this is said to furnish water of excellent quality. A criticism, however, of this site is that it is on very low ground not far from the thickly settled part of the village, and a certain amount of drainage from the latter must penetrate to this point.

A second proposed site is on a hill one half mile above the village, near the location of the Sawtelle Springs, so called. The well and two springs here situated already supply a number of families through an aqueduct. While the adjacent soil is noticeably red in spots, the water is said not to show any evidence of iron. A twenty-foot standpipe erected here would apparently afford service to every house in the village. In my opinion, this is the most promising location. A third place visited is a plot owned by the Columbian Mill Company, located across the river, but it would appear that this affords no advantage over the preceding, and

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as regards increased length of main, pumpage, etc., it is disadvantageous.

Examination of samples collected April 28 by Dr. B. D. Pease from the Sawtelle spring and the spring on the flat near the railroad station, afforded the follwoing results:

	Sawtelle spring	Flats spring
Odor	none	faint earthy
Color	0.03	0.03
Turbidity (on standing)	none	none
Sediment	sl. coarse flocc.	sl. fine fibrous
Free ammonia	0.0006	0.0006
Albuminoid ammonia	0.0016	0.0010
Nitrates	0.006	0.020
Nitrites	0.0000	0.0000
Chlorine	0.07	0.35
Total solids	3.5	7.3
Hardness	0.7	1.2
Iron	0.005	0.000
Colon bacilli	none	none

The above indicates good water in both cases, although the materially higher chlorine and nitrate content in the case of the Flats spring is what might be expected, and serves to demonstrate the greater purity of the other source, so far as possible sewage contamination is concerned. On the other hand, the Sawtelle spring does show a trace of iron, not evident in the other. While the above amount is insufficient to appreciably injure the water, it is possible that the water of a large fairly deep well drilled upon this location might be found to carry a larger quantity, especially in time following extensive draft upon the ground water.

It is evident therefore that both sources, while in a general way representing good water, are neither one of them entirely beyond criticism, although the objection in each case may seem insignificant. If actual use demonstrates that the Sawtelle spring supply is entirely satisfactory for domestic use, affording no trouble, for example, in connection with clothes-washing, cooking, etc., and if it should seem from subsequent examination of a test-well water that the proportion of iron will not be materially greater than that above indicated, then this will doubtless prove the more satisfactory location of the two. While the Flats spring water is at present slightly more attractive in appearance, yet it should be borne in mind that an equally good appearance would not necessarily be true of an extensively drawn-upon well supply in this location, especially at all seasons.

During April, 1913, the chemist of the Board went to Greenville and examined several proposed sources of supply—inclusive of springs and proposed locations for driven wells. As a result, the use of one of these springs was advised against; the other was found to afford an inadequate quantity. and test wells made at this location (Sawtelle Springs) indicated that such quantity could not be readily increased.

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Subsequently, a number of test wells have been sunken in various localities and the water encountered submitted to analysis. Here, too, however, no success was attained; either the quantity was found to be deficient, or the quality was unsatisfactory. Concerning the results of a second visit, made during December, Mr. Howard reports as follows:

During June last, attention was called to a spring situated on the west bank of the Souhegan River, a few rods above the railroad bridge. While this spring has for years been a popular source of drinking water for the neighborhood, it had not been supposed that the flow was sufficient to warrant consideration as a source of public or town supply. Following are analyses of samples collected (a) on June 22, 1913, before any development had been undertaken, and (b) after excavation to a depth of about twenty feet and material increase of the flow:

	Sample (a) No. 11180 June 22, 1913.	Sample (b) No. 11788 Nov. 25, 1913.
Odor	none	ft. earthy
Turbidity	slight	sl. opalescent
Sediment	mod. flocc. earthy	sl. to mod. earthy
Color	.05	.03
Free ammonia	.0006	.0008
Albuminoid ammonia	.0010	.0018
Nitrates	.005	.005
Nitrites	.0000	.0000
Chlorine	.08	.10
Hardness	.6	1.2
Iron	.007	.....
B. coli	negative	negative

With the exception of a little earthy sediment, the above analysis indicates good water, free from excess of iron and any form of contamination. While the soil excavated is sand, the latter contains a few streaks of clay, and for this reason the water shows a slight bluish opalescence at the spring, and deposits a slight earthy sediment in the sample bottle. It is believed, however, that with settled conditions there will be no appreciable amount of turbidity and that the quality will prove very satisfactory.

The original flow of this spring (estimated, it should be noted, during a very dry season) was found to be 25 gallons per minute. On excavation to a depth of about 20 feet, the flow was increased to a volume of 57 gallon—this, however, being later in the year and following a period of rains. It is believed that the amount available will be ample for domestic use. The matter of fire protection is otherwise provided for.

This spring is situated one half mile from the village at the foot of a high wooded bank some 50′ from the river, and rises to a height of 5′ or 6′ above the latter.

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The only possible opportunity for any contamination is from the river itself. The latter receives some of the sewage of Greenville, also a certain amount of mill waste. While the spring normally consists in no part of river water and the chances of contamination from this source under ordinary circumstances are believed to be very remote, yet it is conceivable that were the reservoir pumped to a level much lower than the river, a certain amount of water from the latter might seep in through the intervening soil stratum, although even in such an event the water would have necessarily undergone more or less filtration.

The plan is, therefore, to excavate a reservoir on the site of the spring of about 50,000 gallons, putting in a tight embankment of masonry on the river side of sufficient height and depth effectually to exclude any possibility of entrance of river water.

The supply will be pumped at intervals to a standpipe, to be located on a hill in the center of the village, supplying the mains en route.

The spring project referred to above having been ultimately rejected, consideration was next given to two ponds as possible sources of supply. It is understood that the Pratt Pond source has finally been adopted. In presenting his report upon this pond, Mr. Howard summarizes the situation as follows:

The Water Supply Committee (Mr. F. W. Ely, Chairman), appointed by the town early in 1913 for the purpose of looking up a suitable supply, has already investigated a number of sources, those hitherto consisting of wells and springs and driven well projects. Such have all been abandoned, for one reason and another. Some were inadequate, others showed some evidences of sewage contamination, while others carried iron in amount sufficient to render them non-acceptable. The most recent project, a spring situated on the bank of the Souhegan River a short distance above the railroad bridge, has been rejected because of probable insufficiency, of the expense of pumping and because of lack of adaptability to the existent system of piping. On this date I observed that the opalescence due to suspended clay, and noted last summer, continues. At that time it was thought that in view of the recent excavation, this might be a temporary feature which would eventually clear up. As a permanent characteristic, this feature would tend to impair somewhat the otherwise excellent quality of this source.

Ashley Pond. This pond, located a short distance outside of New Ipswich Village, supplies power to Ashley's mill. Areas not over two acres; bottom, muddy; watershed, level, mainly wooded but has one farm, with buildings. This pond has an elevation above Greenville of something over 200 feet and is distant therefrom three miles

Neither the pond itself nor the analysis of its water are such as to recommend it as a source of supply for Greenville. The degree of color in the sample examined (0.35) is higher than is desirable. The chlorine content also, while by no means excessive, is still somewhat higher than

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that of Pratt Pond, indicating a greater degree of natural purity in the latter case. The proportion of nitrogenous matter in Ashley Pond is not particularly high, as found in the sample examined. This pond is too small to serve as an adequate supply, and the quality of the water is not what it should be for such a purpose.

Pratt Pond. This pond is situated near Smithville, at a distance of about six and one half miles from Greenville; altitude thereabove said to be 400 feet. The watershed, which is a comparatively large one, is altogether wooded and contains neither habitations, farming land nor pasturage. Area of pond estimated at about thirty acres; spring fed; small stream discharges through dam at outlet, evidently once the site of a mill, long since abandoned. Much of the watershed is quite steep, consisting in part as it does of New Ipswich Mountain (southern slope) and a chain of hills to the southwest.

The immediate shores are rather flat and extensively brush-grown, and there are two or three clumps of "brush" growing off-shore. However, much of the shore is rocky or ledgy, with sandy or gravelly edge. The bottom is apparently also mainly sandy, although overlayed in places by a mucky deposit of varying depths and representing deposited vegetable debris. From a study of the situation it would appear that to clean the brush and other growths from the shores would be comparatively inexpensive matter, the doing of which would greatly improve the appearance and render the pond a clean and attractive looking source of supply. It is stated that this pond and much of the watershed can be bought at a reasonable figure, thus permitting absolute sanitary control by the town.

The analysis of a sample of Pratt Pond recently submitted shows that the quality compares very favorably with that of our best pond sources of water supply. The degree of color in this particular sample was quite low—less than one third that of the Ashley Pond sample. As a pond supply, in my opinion, the quality will prove satisfactory, that is if proper attention is given to clearing and maintenance of the shores. It should be pointed out, however, that it is unwise to base a verdict as to quality upon a single sample. It is therefore recommended that during July or August next a series of three or four samples be collected from different parts of the pond, and that these collections be followed later on by samples taken, say, in October, December or January, and in April. In this way we can note the seasonal variation and thus secure a much better idea as to the general character of the water. It is understood that no construction work is likely before next spring.

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LANCASTER.

Under date of February 18, 1914, Dr. Frank Spooner, Secretary, Board of Health, Lancaster, informed the State Board of Health that the water company of that town had notified the public that they were about to pump water from Israel River into the reservoir, on account of shortage of the regular supply, and he asked if the board of health should allow it to be done, requesting a reply by telegraph.

The river referred to being a badly polluted stream, the State Board of Health replied that such action should not be permitted.

On the same date, the following letter was received, together with a copy of the notice of the water commissioners and the fire engineers to the effect that they should begin pumping water from Israel River on the evening of February 19, and advising consumers to boil all the water that was to be used for drinking purposes as a safeguard against any bad effects that might otherwise follow:

February 18, 1914.

Dr. Irving A. Watson,
State Board of Health, Concord, N. H.

DEAR DOCTOR WATSON:

I enclose herewith circular issued today, February 18, by the water commissioners and fire engineers of the town of Lancaster, N. H., which is self-explanatory as far as it goes. There are certain facts not stated on the circular which are important. The intake pipe for pumping water from the river to the reservoir is located in what is known as the Frank Smith & Co. mill pond, situated in the heart of the village. This pond lies between the parallel streets known as Middle and Mechanic Streets, both thickly populated streets. The mill pond in the course of perhaps a quarter of a mile above the intake pipe, receives the sewage from the abutting houses of both these streets. The reservoir is situated a matter of a mile or less from the village. This reservoir is the only public water supply of the town.

I wish to enquire whether or not this proceeding, as set forth in the enclosed circular, is a violation of the public statutes with reference to the pollution of public water supplies, regardless of whether such action is sanctioned or ordered by town officials in the light of what they consider an emergency with reference to fire protection.

Thanking you for any information on this subject, I am,

Respectfully yours,

HOMER B. SMITH.

Enclosure.

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The following is a copy of the circular mentioned in the foregoing letter:

To the Users of Water from the Lancaster Fire Precinct Water System:

Owing to the extravagant use or the wasting of the water by the patrons of the system, largely, as we suppose, to prevent the freezing of their water pipes, which should have been properly protected from frost without making it necessary to waste the water, and as the reservoir is nearly empty and the property in our village is practically without fire protection, we, the Lancaster Fire Precinct Commissioners and Fire Engineers, have decided that it is necessary, under the circumstances, to pump water from the river into the main pipes of the system, and to continue doing so until such a time as the reservoir is at a sufficient fullness to give us a protection against fire.

After 8 P. M., February 19, 1914, and to continue until you are notified to the contrary, by advice of one of our prominent physicians, you are advised to boil all of the water used for drinking purposes, as a safeguard from any bad effects to the users of the water.

The above will be in effect unless the reservoir shows a marked increase during the day and night of the date above given.

W. E. BULLARD,
J. B. MCINTIRE,
C. A. CLEVELAND,
Commissioners.
ALLEN MOYLE,
J. P. WARK,
F. J. WILLIAMS,
Fire Engineers.

Immediately following the receipt of this information by the State Board, its chemist, Mr. C. D. Howard, was directed to go to Lancaster to investigate conditions there. This he did, and a few days later a copy of his report was transmitted to the board of health of Lancaster, as follows:

THE STATE OF NEW HAMPSHIRE,
OFFICE OF THE STATE BOARD OF HEALTH,
CONCORD, N. H., February 24, 1914.

Frank Spooner, M. D.,
Secretary Board of Health,
Lancaster, N. H.

DEAR DOCTOR—Inclosed is a copy of the report of our chemist, Mr. Charles D. Howard, on his inspection of the water situation in Lancaster, on February 19, 1914.

This report is so comprehensive that little or no comment is necessary. The State Board of Health endorses to the letter the recommendations made by Mr. Howard. This board will insist that the following recommendations be carried out by your board:

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1. That no water shall be pumped from the mill pond into the reservoir or into the mains connected therewith, unless:

(a) The water in said reservoir shall be exhausted to within two feet or less in depth, or

(b) In case of a conflagration which might render such pumping necessary to protect the town against serious loss by fire.

2. In case it should become necessary to pump water from the mill pond into the reservoir in either of the above events, the process of chlorination must be started simultaneously with the pumping and be maintained so long as any water is pumped from the said millpond into the reservoir.

A bacteriological examination of a sample of water taken from the mill pond by Mr. Howard and brought to the State Laboratory of Hygiene at the time of his recent visit revealed extensive infection with the colon bacillus, and this at a season of the year when much household drainage which would otherwise reach the pond is presumably frozen, and yet the water is seriously polluted. There can be no question, whatever, upon this point.

The number of buildings that surround the pond, with the sewage that is going into the water, is sufficient in itself, if there were no other known facts, to condemn the water *in toto* for domestic purposes.

The State Board of Health had occasion a few years ago most emphatically to warn the town of Littleton against pumping water from Ammonooosuc River into its mains, but the warning was not heeded, and as a result, in the winter of 1902–3 there occurred one hundred and thirty-nine cases of typhoid fever, with eleven deaths, from using water against which the public had been warned.

In 1903, and previously, the authorities and the public at Woodsville, had been warned against pumping water for domestic purposes from the Ammonoosuc River, but the arvice was disregarded, and forty-eight cases of typhoid fever, with five fatal cases, resulted.

We are certain that the people of Lancaster do not want and cannot afford an experience of this kind. The Woodsville epidemic occurred in the face of the fact that the authorities and the public had been warned that Ammonoosuc River water was unsuitable for domestic purposes, and that if used it must be boiled. As a matter of fact, such a warning is heeded by only a small proportion of water takers in any case.

We regard it as the imperative duty of your board to take these questions into consideration, and to enforce such regulations as may be necessary to protect the people of Lancaster against impure water.

Very truly yours,

IRVING A. WATSON,
Secretary.

The chemist's report follows:

Dr. Irving A. Watson,
Secretary State Board of Health:

DEAR SIR—On February 19, 1914, I went to Lancaster to investigate conditions in connection with a shortage in the water supply and the alleged necessity of augmenting such by pumping from the river.

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Upon the arrival of your representative, a joint meeting of the boards of health and water commissioners was held, during which the situation was discussed. It appeared that on account of the nearly empty condition of the reservoirs, the board of water commissioners had already taken steps preliminary to immediate pumpage therein from the river, and that consumers had been notified of this intended action by the circulation of "fliers" suggesting the boiling of the water. Learning of this, the board of health served a notice of protest upon the water commission, which latter board consented to defer action for a few hours longer. It appeared that this board considered that an extremely hazardous situation existed, and that it would be amply justified, in the interests of property protection, in taking this step, regardless of any other considerations that might be urged. The board of health on the other hand, while acknowledging the danger to which the village was exposed, nevertheless expressed itself as being distinctly opposed to such emergency pumping except in the actual event of an outbreak of fire.

I subsequently made an examination of conditions at the reservoir, also at the river above the proposed point of intake. The supply consists of a spring-fed mountain brook having its source in the town of Kilkenny, from which it is piped to the reservoir, a distance of about six miles. The reservoir is situated one mile from the village, with an elevation of one hundred and eighty feet above the main street, giving a normal pressure of about eighty-five pounds per square inch. The capacity of the reservoir, which is of irregular shape, is variously estimated at from two to four million gallons, no definite information on this point being available. The depth to the point of overflow is twelve feet. The supply is unmetered and no estimate as to the consumption was available. It does, however, serve a population of some two thousand people, with about six hundred services. In addition to some water used for manufacturing purposes, about one seventh of the revenue accruing to the precinct from the sale of water is on account of that supplied to the railroads for boiler use. It may be added that the quality of this supply is uniformly of a very high order.

Examination of the reservoir on February 20, showed a level of but two feet of water. This was considered as favorable, as contrary to the condition on the previous day, no further drop was indicated, notwithstanding that the night had been severely cold, and also that a rather serious leak in one of the street mains had persisted for some two or three hours the previous evening. It seemed to be agreed that the cause of the present shortage was a combination of a deteriorated and leaky condition of the plumbing, together with a habit, become widespread as a result of the unusually severe weather, of leaving the faucets open at night for the purpose of preventing freezing. As opposed to this explanation is the admission that no condition at all closely approaching the present one has ever before occurred during the winter season.

As serving to demonstrate the value and greater economy in a metered system and the carelessness and indifference to waste and the need of plumbing repairs in an unmetered one, it was said to have been admitted

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by one householder that his closet flush tank had been running continuously for three years, while as a result of the present emergency, the local plumbing establishment had booked orders for several days' work repairing faucets. Evidence was also said to have been found that in the case of one house, nine spigots had been left open during the previous night.

The emergency, or fire intake, is at the mill pond dam on a rather small stream locally known as Israel's River, said to have its origin twenty miles back in the mountains. The mill pond is of some three acres area, with an average depth of fifteen feet. Only a brief inspection was made of the sanitary condition of the shores, but this was ample to demonstrate, especially in connection with the admission of the water commissioners that a number of house sewers discharge directly into the pond, that this source as a water supply is necessarily absolutely unsafe and unfit, this notwithstanding that such water may not, and very probably does not, present any very bad physical characteristics. Both shores of this pond are closely lined by houses, very many of which are unconnected with and could not be readily connected with the public sewer. In addition, a number of manure piles, stables and chicken houses were noted close to the water's edge.*

It may be pointed out that while the physical condition of this river water may be somewhat better at this time than it is during the summer season, nevertheless there is, on the whole, actually more danger in the use of this water at this time than there would be in summer, due in part to the absence of those favorable opportunities then existent for the destruction of the sewage forms of bacteria; in part to the fact that in the event of a sudden thaw much filth will necessarily be carried directly and unimpeded into the pond.

In a statement of the situation which I prepared for submission at a meeting of the precinct to be held the evening of February 20, the salient features were pointed out, and occasion was taken to state that assuming it were possible to secure sufficient fire pressure to care for a fire, operating the pump with the water power available, the pumping of such river water into the reservoir with a view of securing storage in anticipation of such an emergency, should be forbidden. It is stated, however, that while under favorable conditions it is possible to develop with this pump a pressure equal to the normal reservoir pressure, yet at times, due to the fluctuation in the volume of water going over the dam, there is insufficient water power to properly operate the pump. It is my opinion, however, considering all the facts, that there would be justification for restraining the board of water commissioners from such pumping into the reservoir, unless the present level should decline materially, i. e., unless such reservoir should become practically empty. Actually, it would appear that no further diminution is likely, and it seems to be the present sentiment of the board that under the present circumstances, it would be disposed to refrain from river pumping.

*A sample of water collected from beneath the ice in the wheel pit of the grist-mill gave positive results by the presumptive test for colon bacilli on 10cc., 1cc. and 0.1cc quantities.

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However, in the event either of the reservoir becoming empty, or the outbreak of a fire, the necessity of applying a sterilization to the river water was emphasized, and full details for effecting this were left with the board of health. It was promised by the constructor that the barrels, together with the necessary piping, and a water-closet flush tank to serve as a constant level tank, should be assembled in place, ready for use, during that afternoon (February 20). Based upon the estimated capacity of the pump operating under the conditions obtaining of ten thousand gallons per hour, a treatment was devised which would involve a dosage of approximately 0.5 parts chlorine per million, such, if conscientiously applied, being ample to render this water safe for drinking. I have, however, recommended that for the present at least, as a further check, the water be boiled by the consumer, following any emergency pumping.

It has been proposed that this emergency intake be moved to a point above what is known as the upper dam. It seems to be agreed that the stream at this point is not subject to any great amount of domestic sewage pollution. Unfortunately, there was neither time nor favorable conditions for any adequate inspection to verify this view. In case the change is made, it is believed the board would be justified in regarding such as coming under the law passed by the legislature of 1913 and that an inspection and the approval of the board should be secured.*

It may be added that in view of the fact that practically every public water supply is provided with an emergency intake, such frequently if not usually being in a polluted source, and that also in view of the fact that many water superintendents or water boards are inclined to place property protection above health protection and to belittle the likelihood of any serious consequences arising as a result of emergency pumping, there should be more extensive oversight of such intakes by the State Board of Health. It would seem that such board ought not only to exert a specific authority in regulation of the use of water from sources of this character, but also that it should, in the event that a choice of location is available, have something to say as to where such shall be placed, also as to the sanitary character of the surroundings.

Respectfully submitted,

CHARLES D. HOWARD,
Chemist.

February 21, 1914.

The matter of relocating the emergency intake in Israel River in connection with the Lancaster water supply having arisen, the chemist of the board went to Lancaster June 9, 1914, for the purpose of examining conditions on this river. His report, as well as the letter of transmittal and the order of the board issued in connection with the matter, follow:

*See report following.

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THE STATE OF NEW HAMPSHIRE,
OFFICE OF THE STATE BOARD OF HEALTH,
CONCORD, N. H., June 11, 1914.

Mr. W. E. Bullard,
Chairman Board of Water Commissioners,
Lancaster, N. H.:

DEAR SIR—Inclosed is a copy of the report of our chemist, Mr. Charles D. Howard, on his recent examination of the situation with respect to the emergency water supply from Israel's River.

I think a careful reading of this report will convince you that the position taken by the State Board of Health in the inclosed order is certainly justifiable.

There can be no question that the water of Israel's River, unless chemically treated, is dangerous for domestic purposes.

The carrying out of the inclosed order will not entail any unreasonable expense, and it is in accordance with the proposition which I think was assented to by your company in February last, when some question arose regarding your water supply.

I would emphasize the statement in Mr. Howard's report, that if the present supply were conserved there probably would be no need whatever of pumping water from the river.

Very truly yours,
IRVING A. WATSON,
Secretary.

Inclosures.

THE STATE OF NEW HAMPSHIRE,
OFFICE OF THE STATE BOARD OF HEALTH,
CONCORD, N. H., June 11, 1914.

Board of Water Commissioners,
Lancaster, N. H.:

GENTLEMEN—A careful investigation of Israel's River and its tributaries reveals the fact that this stream receives at all times more or less sewage, which renders it a dangerous source of water supply for domestic purposes. It is, therefore,

ORDERED, That no water from Israel's River shall be pumped into the town supply pipes except in case of great emergency (such as a conflagration), and that all water so pumped shall be chlorinated in accordance with specifications approved by the State Board of Health, and that all households and other establishments using the said water shall be immediately notified of such action.

Per order,

IRVING A. WATSON,
Secretary.

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MR. HOWARD'S REPORT.

CONCORD, N. H., June 9, 1914.

Dr. Irving A. Watson,

Secretary State Board of Health:

DEAR SIR—The matter of re-locating the emergency intake in Israel's River in connection with the Lancaster water supply having arisen, I went to Lancaster on June 9 for the purpose of studying the situation. In this examination of conditions on the above-named river, I was accompanied by Mr. W. E. Bullard of the board of water commissioners.

This emergency intake, at present located at the gristmill dam, is operated by a pump designed to force river water at considerable pressure into the mains in the event of an extensive fire.

Because of sanitary conditions on the pond above (pointed out in an earlier report), water drawn at this point cannot be considered as fit in any sense for drinking purposes, or as a suitable adjunct to the main supply in any other respect than for the extinguishing of fires.

However, it is represented that at times the level of the water in the reservoir drops materially below the overflow point (12 feet). On a few occasions the level has been greatly reduced, and it is therefore the desire of the commissioners, with a view to maintaining at all times satisfactory fire protection, to be able to pump from some suitable source, at such times as may seem expedient, sufficient water to maintain the normal level.

Whereas in the past such pumping has been practised in very rare instances only, I should infer that the present intent in re-locating the intake involves the expectation that water of sufficiently good quality would be secured as to permit of pumping into the reservoir at any time when it might seem expedient to do so, and without, necessarily, notifying the consumers of such action at the time.

The quality of the present Lancaster supply is hardly excelled by any other public supply in the state. This high quality is distinctly a valuable asset of the town—something in which its citizens may justly take pride. It is manifest that the introduction of any inferior auxiliary source would be unfortunate; and it is, therefore, not at all likely that the people of Lancaster would care to consider the use, even during very short or infrequent intervals, of a supplementary system of distinctly polluted origin.

This emergency intake re-location included two propositions: 1st. To establish the pump at the Jones & Linscott Electric plant, some half mile or more above the gristmill, with the intake at the canal dam furnishing power for such plant; 2d. Pumping from the same point, but extending the suction pipe up the canal to the old paper mill dam on the main river. The later course would avoid some contamination from the Maine Central Railroad roundhouses, situated just above the Jones & Linscott plant.

An examination of the sanitary conditions above the latter plant showed the following facts: Just opposite the railroad roundhouse, two sewers discharge into the canal. The first includes the discharge of a

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flush tank, also the washings of locomotive boilers, inclusive of boiler chemicals, etc. The second, while said to be a small natural brook, is nevertheless charged with street washings, etc.

It is true that by extending the suction pipe some seven or eight hundred feet up to the river dam, the roundhouse contamination would be avoided.

One fourth mile above this dam is a second dam, supplying power for the Lancaster & Jefferson Electric Company. This plant employs two men; no closet; employes state that they "go to the river," or else use a closet discharging into the river and attached to an abandoned mill immediately above.

At this plant it was said that there is a practice of dumping garbage of all descriptions into the river. Between the two dams there are but two houses on the immediate watershed, neither of which sewers directly into the river.

A half mile above the upper electric plant is the Quimby brickyard, employing a half dozen men; one dwelling attached, with earth closet; wash from brick machines discharges on the grass a number of rods from the river.

Otter Brook discharges into Israel's River about one and one half miles above the gristmill. Just above this junction there are located on or very near the brook some eight or ten sets of farm buildings, inclusive of dwellings. One half mile farther up this brook is a small village known as Grange, a collection of some fifteen dwellings, with two stores, sawmill, blacksmith shop, etc. The sewer entering the brook at this point includes the discharge, it was represented, of four flush closets, besides the street washings entering at the grating, and there are at least two other flush closets delivering into the brook, not to mention seepage from various sink drains, etc., eventually reaching this stream.

From this point we proceeded to the village of Jefferson Hill, noting from an elevation on the way the location of the regular supply intake in a mountain brook some five and one half miles from the reservoir. It could be observed that this section is practically all wooded, with no apparent possibility of sewage contamination.

At Jefferson Highlands we were informed by responsible parties that there are two sewers (a) that of the Waumbec Hotel and cottages (at this date still closed), and (b) a sewer serving a number of private residences and connecting with that from the hotel property. The combined sewerage, it was stated, enters a brook at a point one fourth mile from the river, thence reaching the latter stream. From this point, the flow to Lancaster is estimated at about eight miles, much of the way, it was noted, being through open farm land with the usual farm buildings.

It will be observed, therefore, that in addition to the small amount of pollution entering the river just above the Jones & Linscott plant, there is a material amount discharging therein from Grange. More serious still and affording a source of very great danger during the summer season, is the sewage discharged from the Waumbec Hotel at Jefferson—a place accommodating five hundred persons.

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It is futile to suppose that the subsequent river flow of eight miles is sufficient—or anything like sufficient—to purify the river of this extensive contamination and render its water safe for drinking.

It should be obvious, therefore, that any plan involving direct pumping from the river, unannounced, and with the view merely to maintain a satisfactory stage of water in the reservoir, ought not to be seriously considered except in time of dire emergency, and even then only when accompanied by the use of the chemical treatment already prescribed, and followed also by an immediate warning to the consumers.

The only advantage, therefore, in changing the present location of this emergency intake would be that, in the event of a serious fire demanding river pumping, an intake at the upper point mentioned would afford water of a somewhat cleaner character, thus involving somewhat less serious fouling of the mains.

It would appear, however, that there is yet much that can be done, and at relatively small expense, in the way of augmenting the present high quality brook supply.

There seems ground for a belief that by going a few hundred feet farther up the brook, the present "head" would thereby be materially increased, affording a corresponding increase in the quantity discharged at the reservoir in a given time. It is stated that extensive repairs at the brook dam will be necessary at a very early date, so that the present is a favorable time for the re-location of such dam.

A second means of increment is through enlarging the reservoir storage. Thus it was noted that water was wasting at the overflow at a rate of five to ten gallons a minute. At night the wastage would be greater, as it also doubtless was during the past very rainy season. There is no reason, whatever, why this wastage should be permitted to occur, especially in the face of any question as to the securing of more water. Storage would in no wise injure the quality, and it is estimated that by simply joining on an upturned bend to the inlet of the overflow pipe, with practically no other expense whatever, beyond possibly a little grubbing off of vegetable matter, an increased depth of at least one and one half feet could thereby be secured. And by the expenditure of a comparatively small sum for raising and strengthening the reservoir embankment slightly, it would appear that the available maximum stage could be raised at least three feet above the present. This would mean really a greater increase of storage than might at first appear, in view of the fact that the shores shelve off very gradually, the area of the lower three or four feet of depth being very much less than that of the full reservoir area.

By a combination, therefore, of increased storage and increased delivery capacity of the supply main from the brook, it would appear that a materially increased supply of the pure brook water might thereby be attained, thus rendering it unnecessary to pump dangerous river water into the system, except in the event of an extraordinary emergency.

Respectfully submitted,

[Signed] CHARLES D. HOWARD,
Chemist.

June 10, 1914.

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Woodsville Water Supply.

For a long time the character of the Woodsville water supply, drawn direct from the Ammonoosuc River without any subsequent purification, has been a serious menace to the safety of the citizens of this village. Notwithstanding that warnings have been from time to time issued against using this water for drinking purposes without boiling, and although the more intelligent of the consumers understood its dangerous nature, yet there is evidence showing that many did not scruple to drink the water with more or less regularity.

During 1913, the situation was studied by the chemist of the board, who submitted a report as follows:

Dr. Irving A. Watson,
Secretary State Board of Health:

Dear Sir—In company with Health Officer Johnson, on June 30, 1913, examination was made of the various sources of water and ice supply of the village of Woodsville.

At the present time there are three sources of public water supply, viz., the Ammonoosuc River, Wilmot Springs, and the James Gordon Spring. The first two are operated by the Woodsville Aqueduct Company, which is a subsidiary company of the Boston & Maine Railroad. A further spring supply, that of Jas. R. Lowe, at present furnishes water to but two tenements only. Until this year quite a good deal of spring water has been hauled into the village from the Mitchell spring, located a short distance over the boundary line in the adjoining town of Bath, but this is now discontinued. The location of this spring was noted as being well above any possible contaminative agencies. In addition to the above, a spring known as the Dearborn spring, located one half mile south of the village, is resorted to somewhat extensively by the neighborhood residents. While the surroundings here are favorable and the water is doubtless of good quality, the practice which prevails of promiscuously dipping receptacles into the basin is objectionable.

The Gordon spring, which supplies about thirty-three families, is located in meadow land at the northern edge of the village. This spring was found to need cleaning. It should be extended with cemented brick or stone above the surface for a sufficient distance to prevent any influx of surface water during periods when the adjacent land is overflowed. The surroundings are satisfactory. Galvanized iron pipe is used throughout. The quality of this supply is good.

Wilmot Springs. This is the original source of supply of the Woodsville Aqueduct Company, and consists of a large spring or pool, with two "feeders," situated in wooded pasture land one and one half miles southeast of the village, the water being conveyed thereto through a lead main.

At present this property is in a condition of extreme dilapidation. The brick wall enclosing the pool collapsed some time ago, and forms a pile of ruins standing in the water, while the shed covering the spring is tottering.

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The wooden covering over the feeding springs is rotten and falling in, while, as serving to demonstrate the lack of any recent oversight, reference may be made to the fact that a badly decomposed rat was observed lodged in the extremity of the intake pipe. Evidently nothing whatever has been done for many years in the way of upkeep, and from all appearances the supply is an abandoned one.

Standpipes. And yet the people of Woodsville, the more intelligent of whom very properly refuse to drink the river water, daily flock with pails and pitchers to the "standpipes" for what they regard as "pure spring water." These standpipes, five in number and receiving the supply from Wilmot Springs above mentioned, are distributed throughout the village and consist of ordinary sized service pipes extending upright from the sidewalk and terminated by spigots. One or two of these are housed over and are supposed to furnish water throughout the winter, though as might be anticipated, there is complaint that these not infrequently are out of commission on account of freezing. Except therefore for the latter and a few private wells, the raw river water is the only source of supply available at this season to the majority of the consumers.

It was found that there is considerable suspicion on the part of some of the consumers that the so-called "standpipe" water is not all spring water, but that there is a connection between this and the main river supply. Direct interrogation of the company's superintendent, Mr. E. J. Mann, as to this point, brought forth a vigorous denial that any river water whatever mingles with the spring water at any point or at any time.

Inquiry as to the manner in which the company secures remuneration for this standpipe water revealed the fact that none is received. In other words, the company furnishes this Wilmot Spring water free, thereby virtually admitting that its main supply is unfit or unsafe for drinking purposes. The standpipe system, it would seem, is therefore merely a pacifier, offered consumers with the hope that thereby the company may escape being compelled to take such measures as may be necessary to render its regular supply suitable for drinking; possibly a more just view would be that the above is a measure of procrastination designed to tide over the time until it shall appear financially expedient to make necessary improvements already contemplated. While the standpipe expedient should not be allowed much longer to operate to deprive the people of Woodsville of a safe water supply, yet so long as this system is kept in use there should be proper maintenance of the source of supply. That this water is at times dangerously contaminated by lead is bad enough, though it would probably not be expedient, under the circumstances, to go to the expense necessary to remedy this feature.

Ammonoosuc River Supply. It is common knowledge that this, the present source of supply of the Woodsville Aqueduct Company, is polluted to a dangerous degree through the discharge of both domestic and industrial sewage by the various towns situated on the river immediately above. The point of intake is at a dam which furnishes power for water pumping and current generating and which is located a few rods above the confluence with the Connecticut River. The water is conveyed to the intake pipe through a flume, and is said to pass during its course through some eight inches of sand.

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Access for inspection of this "filter" was not available. This sand bed is said to be cleaned three or four times a year, its object obviously being merely the removal of the coarser suspended particles.

The daily pumpage is estimated as being 450,000 gallons, about one half of which is consumed by the railroad. No reservoir is used, the water being pumped directly into the mains, where by means of an ingenious regulating device operating upon the water wheel, uniform pressure is constantly maintained.

A strong odor of sewage, noticeable in the neighborhood of the pumping plant, was traceable to the discharge into the river of two sewer pipes at a point some fifty feet below the intake pipe. It seems apparent, however, that there is no practical possibility of contamination of the pumped water through any back flowage, although the nearness of this sewer discharge to the intake is certainly objectionable.

Typhoid Fever in Woodsville. I am informed by the health officer that during 1912 fourteen cases of typhoid fever occurred in the village of Woodsville, while since February first of the present year there have been eight cases. The remark made in this connection by a local citizen to the effect that there is "probably no more fever here than anywhere else, considering population" reveals a not unnatural ignorance as regards typhoid statistics. While the population of Woodsville precinct was not learned, it is of course but a fraction of that for the town of Haverhill, which is approximately 3,500, according to the last census, so that, based upon the above figures, the typhoid case rate for Woodsville would be not less than seven hundred to eight hundred per 100,000. Compare this with Concord, for example,—a city which ranks exceptionally high among other cities of the United States for its low typhoid rate. In Concord the total number of reported cases, on the 100,000 population basis, was:

During	1908	28 cases
	1909	130 "
	1910	74 "
	1911	47 "
	1912	70 "
Average,	5 years.....	70 "

That is, based upon the number of cases during 1912 and those to date for the current year—admittedly a limited period for statistical purposes—it appears that Woodsville has in the neighborhood of ten times as many cases of typhoid fever as does Concord, calculated to the same basis of population. It will hardly be questioned that this data, notwithstanding its meagerness in the case of Woodsville, is at least sufficient to demonstrate the existence of some serious hygienic defect in connection with the general life of the latter community. In searching for an explanation of the above wide variation, none is to be found in any peculiarities as regards general local conditions or character of population. While Woodsville is a railroad center, and people are "coming and going" to a greater extent perhaps than may be the the case in the average community, yet this is no less true of Concord. The only essential difference between the two places, bearing upon the point under discussion,

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is that, whereas Concord's water supply is pure, that of Woodsville is definitely known to be polluted in such manner that its use for drinking purposes not alone might, but necessarily *must,* according to all our knowledge on the subject, be responsible for a certain amount of typhoid fever.

Admittedly, it would be unfair to give the water supply full credit for all the typhoid cases. As in every other community, a certain proportion of these cases are undoubtedly contracted outside of the town or from other causes than a polluted water supply. Also, a diagnosis unconfirmed by a Widal examination is by no means infallible, so that not all cases reported as typhoid fever are actually such. On the other hand, as is well known to you, many physicians are extremely negligent about the reporting of cases to the local health officer, and this is all the more apt to be true where a given disease is more than commonly prevalent, or where public knowledge of its existence is liable to cause reflection to fall upon some interest. In fact, in this instance, the health officer informs me that in connection with certain physicians, he has frequently had difficulty in securing reports, and would never learn of any of their cases at all were it not that he chanced to hear of them from other sources. Under such a system, there is no estimating how many cases occur that fail of official record.

Another feature of some interest in connection with typhoid at Woodsville is that examination of such records as have been made during the past ten years discloses that very few deaths from this disease have occurred, the presumption therefore being that most of the cases are of mild character. The latter is characteristic of so-called "city typhoid," that is, of that form of typhoid prevalent in communities where the public drinking supply is contaminated. This is explainable on the theory that prolonged existence by the bacillus in such an abnormal and unfavorable medium as water induces a condition of "attenuated virus." In the perfectly well person the ingestion of such bacilli may cause no infection whatever, or may at the most give rise to some disturbance of diarrhoeal nature. This of course serves as answer to the question of the wife of one of the patients interviewed. Though admitting that her husband was in a "run down condition" before being sick, yet she declared that both she and some of her neighbors drank the river water, and if the latter was responsible, "how is it that we, too, are not sick?"

Quality of the River Water as Indicated by Analysis. Unfortunately, our records include but meager analytical data with regard to this supply, it appearing that but five samples, known with certainty to represent the river source, have been examined during the past six years, and it so happens that none of these examinations have afforded any definitely positive evidence of a contaminated condition. But because of the varying character of a source of this nature, a few such widely isolated analyses as these are of no great value in connection with a recognition of contaminated conditions. For example, a sample of the river water collected at one hour might be found to contain many colon, or sewage bacteria, while those collected during several succeeding hours might afford entirely negative results. Again, typhoid bacilli might be existent in the supply at a certain hour during one day and not be present again—at least in numbers sufficient to cause trouble—for weeks. Once such bacteria are removed from their habitat—the body—they commence to die,

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and it would be impossible to predict just when, how often, or in what numbers and degree of viability, they will be found finally existent at the point of supply intake. The old idea that a few miles of flow serves for the safe purification of a polluted stream was long ago demonstrated a fallacy, although it is one that may still be frequently encountered. The point, finally, is that it is not necessary in such a case to depend upon analysis as evidence of contamination. The fact that actual inspection reveals that there is such contamination may be regarded as sufficient.

Remedy. The company has a choice between securing a satisfactory supply elsewhere and effecting proper purification of the present source of supply. The quality of the Ammonoosuc River water is normally good, and with efficient treatment would undoubtedly afford an acceptable supply. Whether the process adopted ought to be that of slow sand filtration, or the mechanical variety using a coagulative agent, is something that will require further study to determine, including more extensive analyses than have as yet been made. Pending any permanent arrangement, however, I desire to urge the immediate installation of some method of chlorination treatment. Using chlorine gas, as is now the case at Somersworth, is an inexpensive and simple treatment, and one that can be installed in a few hours.

There can be no question that purification of the water supply will mean the saving in the future not only of lives but of a very considerable amount of the suffering and expense entailed by typhoid fever. While the former cannot be readily reckoned in terms of dollars and cents, the expense incident to lost time, as well as all the items of cost in connection with a long period of illness, can be. And, in so far as the weight of even presumptive evidence only might point to the water supply as being responsible, the owners thereof could undoubtedly be held legally liable for such expense.

Sources of Ice Supply. These were also investigated on the same date. It appears that ordinarily the supply for both the villages of Woodsville and Wells River—furnished by one company—is cut from the Connecticut River at a point some distance above the village, the ice-houses being located on the Vermont side. At times, however, some ice is said to be taken from Crabtree Pond, which is a part of Wells River, situated three fourths mile above the village of that name. Much of last winter's crop, I was informed, came from a small brook a short distance north of Woodsville. All of these sources of supply were visited by me, and nothing of distinctly objectionable character noted, although the ice cut from the brook, because of the lowness of the latter during last winter, is not as free from suspended matter as good quality would demand. As bearing upon the preceding discussion, it may be pointed out that it is now recognized that there is very little risk of infection resulting from ice, a few weeks' storage being sufficient to render such practically sterile. While there could of course be no possible sanction for the cutting of ice from a grossly contaminated water, yet the principal desideratum in connection with ice is that it shall be clean, free from excess of mechanically suspended particles, and afford a clear water on melting. It appears that ice dealers, as a rule, aim to grade their ice as far as possible, the dirtier ice being used mainly for the larger storage refrigerators, where it does not come in contact with food or drink. In the case of the present Woodsville

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supply the proprietor informed me that he splits his cakes longitudinally, delivering only the clear stratum where the ice is to be used for addition to water, etc., the inference being that the rest of the cake was thrown away. It was finally admitted, however, that in filling the average domestic refrigerator, such separation of clean from dirty strata was not very rigidly practiced.

Respectfully submitted,

CHARLES D. HOWARD,
Chemist.

July 11, 1913.

ACTION OF THE STATE BOARD.

At a meeting of the State Board of Health held April 30, 1914, the matter of the Woodsville Water Supply was again taken up and considered. It was the unanimous opinion that some executive action would have to be taken before a safe water supply would be furnished by the village of Woodsville.

Many reports have been made in the past showing the polluted condition of Ammonoosuc River and that it constituted a dangerous water supply in an untreated state. The sewage of most of the localities from the mountains to the mouth of the river enters the stream, chief among them being Lisbon and Littleton, not to mention some smaller towns.

The action of the board at the meeting referred to is embodied in the following communication:

THE STATE OF NEW HAMPSHIRE,
OFFICE OF THE STATE BOARD OF HEALTH,
CONCORD, N. H., May 4, 1914.

Mr. G. E. Cummings,
Superintendent Woodsville Aqueduct Co.,
Woodsville, N. H.:

DEAR SIR—At a meeting of the State Board of Health held at the office of the board on Thursday, April 30, a careful review was made of conditions at Woodsville in connection with the public water supply furnished by your company, and the result exhibited the prevalence of typhoid fever there, year after year, tremendously in excess of any other locality in the state in proportion to the population.

The board carefully examined past reports and correspondence relating to this supply, and while much has been expected from your company to remedy the dangerous conditions which have so long existed, it appears that nothing definite has been accomplished, although it is understood that you have employed experts to examine into the feasibility of establishing a chlorination plant.

Inasmuch as the process has proven efficient, and as liquid chlorination

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apparatus has been perfected to a degree that makes it practicable, as demonstrated by systems now in use, the board unanimously adopted the following:

"*Voted,* That the Woodsville Aqueduct Company be and hereby is directed to install, within thirty days, a chlorination apparatus for the purification of water pumped from the Ammonoosuc River, and further that the said company be urged to provide a filtration system in connection therewith."

Per order.

IRVING A. WATSON,
Secretary.

Under date of May 5, the foregoing communication was acknowledged by Mr. G. E. Cummings, Superintendent Woodsville Aqueduct Company, but he stated that thirty days would be too short a time in which to make the alterations necessary to comply with the order, and asked for an extension of at least ninety days.

Following this there was considerable correspondence between the board and the water company, including the consideration of other possible supplies for domestic purposes, the difficulties in the way of accomplishing what was desired, the financial inability of the company to make extensive changes at this time, etc.

The company has never denied the need of improvements, and it is only just to it to say that the water takers have been constantly warned of the dangerous character of the water pumped from the river. Quite a proportion of the community have obtained water from other sources; but there is always a certain percentage of the population that do not heed sanitary warnings of this kind. The frequency of typhoid fever in that locality is evidence of the truth of this statement.

The application for an extension of time in which to comply with the order of the State Board of Health was considered at a meeting of the board on July 9, at which time it was

"*Voted,* That the Woodsville Aqueduct Company be allowed until October 1, 1914, in which to furnish a safe water supply for the village of Woodsville, either by establishing a separate system from an approved source, or by some treatment of the Ammonoosuc River water as has already been recommended."

In accordance with the order of the State Board of Health, the company established a purification system in connection with its automatic pump, to the satisfaction of the board. The installation was inspected September 14 and as bacterial analyses have indicated a satisfactory degree of sterilization, the system has been approved as calculated to render the water safe for drinking purposes. The treatment (chlorination) is the same as at Somersworth, except that an im-

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proved form of apparatus is employed. It should not be assumed that the latter solves the whole problem of water purification in this case. Ultimately a system of filtration in conjunction, such as is in use at Lebanon, Exeter and Berlin, should unquestionably be provided also. However, Ammonoosuc River water is normally of fair quality physically, and the sterilization treatment, if faithfully carried out, can be depended upon to render the supply quite safe with the possible exception of periods when excessive turbidity prevails. At such times it will be desirable to increase the dosage somewhat, and also to keep careful watch as to the character through bacterial examinations.

LISBON.

The following communication received March 27, 1914, is self explanatory:

LISBON, N. H., March 26, 1914.

Irving A. Watson, Esq.,
Secretary State Board of Health,
Concord, N. H.:

DEAR SIR—At the recent annual meeting of the voters of the Lisbon Village District, the undersigned were elected a committee to inquire into the service and charges of the Lisbon Water Works, and to act on behalf of the district in making a thorough and comprehensive inquiry and investigation into its water supply, and to this end also to petition the aid of such state boards and commissions as may seem proper and reasonable.

There is a general and well-founded belief in Lisbon Village District that the water supply is not as pure and sanitary as it should be. That certain improvements are not only desirable but necessary is apparent to anyone having but little knowledge of the exisiting conditions.

We would like your coöperation and advice in this matter. No doubt you will be willing to send a representative here to make suitable investigation and render report. We shall be pleased to aid or coöperate in any action the State Board may see fit to take in the premises.

Yours respectfully,
E. O. CROSSMAN, M. D.,
B. S. WEBB,
G. CONRAD BRÜMMER,
Special Committee on Water Supply
Lisbon Village District.

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As an initial procedure under the foregoing request for an examination into the conditions attending the Lisbon water supply, the source was visited by the chemist of the board April 6, 1914. Following a recommendation by the latter, the special precinct committee appointed to consider the matter of water supply invited Professor Robert Fletcher to make an investigation, particularly as to certain engnieering features in question. The reports of these gentlemen are appended.

The questions both of quality and adequacy of service and fire protection being involved, the committee later addressed a petition to the Public Service Commission, which gave a public hearing in the matter on September 15, 1914, at which hearing both Professor Fletcher and Mr. Howard appeared and gave testimony favorable to the petitioners. The case at this date is still pending, a later hearing being scheduled for the introduction of testimony as to rates.

Dr. Irving A. Watson,
Secretary State Board of Health:

DEAR SIR—The following facts were ascertained as a result of an investigation of conditions pertaining to the Lisbon Water Supply, made April 6 and 7, 1914:

This supply is owned by H. B. Moulton. At a recent precinct meeting a committee consisting of Dr. E. O. Crossman, B. S. Webb, and G. C. Brummer was appointed for the purpose of making a thorough investigation of present conditions, with a view to securing certain improvements believed to be desirable.

The inspection was preceded by a conference the evening of April 6, at which were present Messrs. Crossman, Brummer and Moulton. At this time the fact was brought out that the supply has been subjected to criticism on the ground that it is at times quite turbid, that unsanitary or objectionable conditions exist on the watershed and on the brook leading to the reservoir, and that in certain sections of the village the pressure is inadequate.

It is the committee's desire that the matter be very thoroughly gone into, and that with this in view, an engineer should be employed for the purpose of making such surveys, estimates, etc., as may seem advisable.

As pertaining to the criticism of inadequate pressure, Mr. Moulton offered in explanation a statement to the effect that such was due to an extension of the main pipe system with a smaller bore wrought iron pipe, which latter had become somewhat clogged by rust. It was represented that this condition is to be corrected immediately.

The superintendent claims that the normal Main street pressure, with services shut off, is 108 pounds, or 97 pounds under usual conditions.

The system, which is unmetered and which furnishes water to 1,500

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people, has its source in Mink Pond brook, a stream flowing from Mink Pond (now known as Pearl Lake). This pond, situated two miles to the northeast of the village, is about three fourths of a mile long by a half mile wide at the widest part, and is said to include about seventy-five acres. From the southwest extremity to the dam at the reservoir, the flow of the outlet brook is about three fourths of a mile, with an estimated fall in this distance of 150 feet. The reservoir capacity is stated by the superintendent as being approximately 1,000,000 gallons. Throughout the whole distance the highway winds very close to the brook, the natural gorge formed by the hills on either side being no more than wide enough, much of the way, for the comfortable accommodation of both.

It has been alleged that the turbidity always existent in early spring and particularly following heavy showers, is the result of wash from this roadway. The superintendent, however, pointed out that the brook would be turbid at such times were there no roadway, on account of erosions of exposed gravel strata in the bluffs overhanging the opposite side of the brook. The existence of these exposed strata, with opportunity of erosion, was pointed out by Mr. Chamberlin, as well as the attempt in the past to remedy this condition through construction of log coverings.

It was observed that during the greater part of the distance from the reservoir to the pond, the roadway is tilted at a slight angle, so that but very little wash could get into the brook, such going rather into the opposite gutter and being carried off below the reservoir. However, at a point about half way there is a water bar, which serves to convey all of the water into the gutter above the point directly into the brook. Still further up, a small tributary brook passes under the roadway through a culvert, carrying with it the water from the gutter. It is probable that the volume of this small brook is at times too great to permit of its being cut off from the main brook, and instead is conveyed in the gutter to below the reservoir. However, it might easily be carried through a tile under the gutter flow, and also the water bar referred to be removed. I am convinced that were this done, and perhaps some of the bank on the opposite side of the highway cut into a little more deeply, depositing the earth on the brook side, practically all of the highway wash could be handled by the gutter and thus carried below the reservoir. To accomplish this would merely require a little coöperation on the part of those responsible for the care of the roads with the water-works management, a coöperation said to be non-existent at present.

As stated, the superintendent believes that very much of the turbidity is due to wash from the opposite bluffs, and he asserts that each year it has been his custom to draw down the reservoir and clean the bottom, removing in this process several loads of what he represents as being the best of gravel for highway construction.

Although the roadway also very closely skirts the southwest shore of the pond for the distance of a half mile from the brook outlet, it is said that the pond water is always free from turbidity. A sample of such water is to be collected at the pond outlet. At the latter point the shore and bottom are somewhat muddy, though it is stated that the greater part

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of such elsewhere is sandy or gravelly. On account of the existent snow and ice, observation in this connection was impossible at the time.

The sanitary conditions observed following a complete circuit of the pond are to be classed as poor. At the upper end of the pond are four sets of farm buildings, two of which are directly on the watershed and distant about a quarter of a mile from the water, the other two being also on the watershed of the brook, which is the main feeder of the pond. The intervening land is under cultivation and slopes at about thirty degrees. The existence of four large manure piles was noted on this part of the shore, the soluble matters from which are bound to be largely carried into the pond during rains, the objection in this respect being much greater at this time and during the winter than it would be during the summer months, the time when people are inclined to imagine there is most danger.

This pond is evidently the result of the natural damming up of a brook in a depression surrounded by hills, Mink Pond brook very evidently being merely a continuation of a good-sized brook which discharges into the pond at the eastern extremity. However, it is doubtless true, as claimed, that the volume of the pond is very largely augmented by springs. In fact, it is claimed that there is a considerable similar increment in the volume of the reservoir brook.

In addition to the main entering brook, the pond also receives the discharge of two smaller streams on the northern shore, not to mention a tiny brook which enters near the ice house. On this northern side, the existence of six summer cottages and of two sets of farm buildings was noted. None of the cottages is provided with a cesspool, it apparently being the custom to allow the sink water and slops to go out on to the surface of the ground. In most cases the privies are located well back from the water's edge. One of the cottages is built out over the water.

The Guilmette farm buildings are located about 500 feet from the shore. Lakeview Cottage consists of a large double farmhouse, with barns and other buildings, situated about opposite the pond outlet. At this place a lot of manure had been gotten out, being deposited so that wash therefrom tends to enter the pond.

Below Lake View Cottage farm and situated on the reservoir brook watershed, is the Jessman farm. The small brook first referred to passes these buildings in its course under the roadway to the main brook (see sketch map). It should be stated that probably the greater part of the pond watershed consists of open land, much of it under cultivation. The northeastern shed is covered with an evergreen growth.

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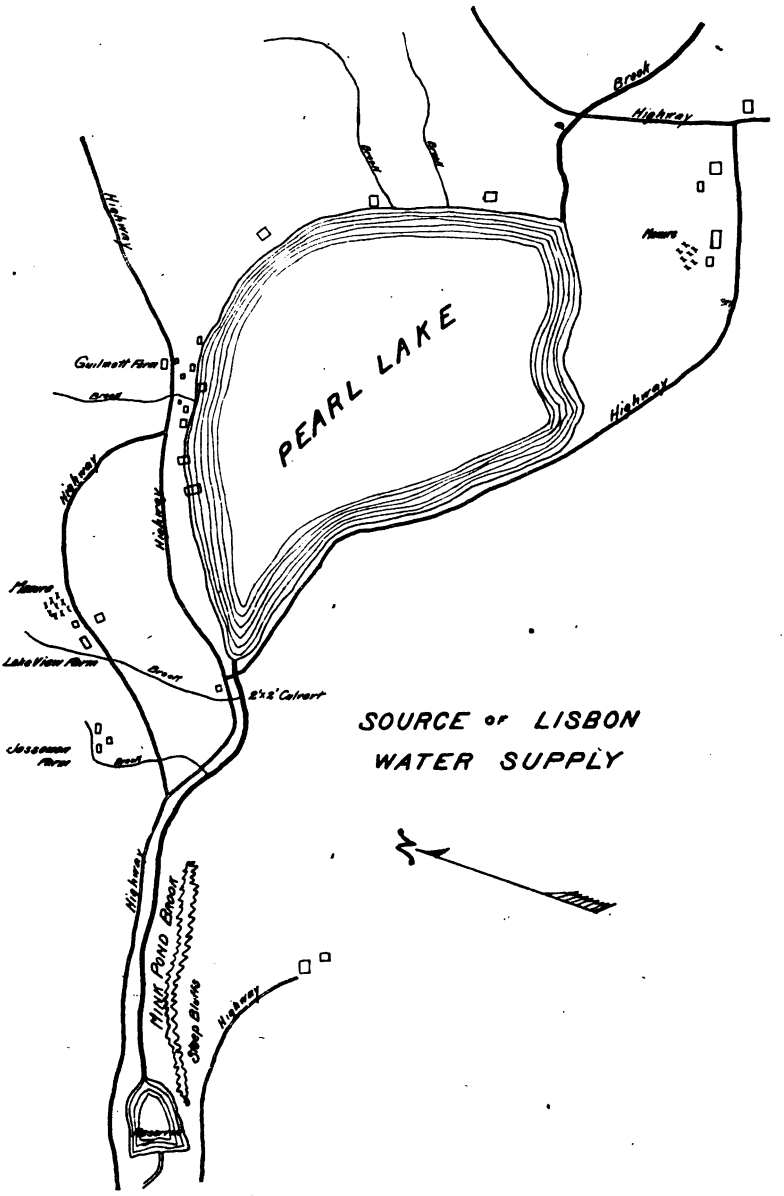

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A very serious feature was discovered in connection with the disposal of sewage from the Lake View farmhouse. This is a water-carried system, and it was represented that the discharge was on to the open ground at a considerable distance above the brook. Investigation, however, showed that at this time the sewer discharge was being borne by a small brook down to the lower roadway and thence directly into the main brook.

Abundant evidence of this sewage was observed in the odor and appearance of the water, as well as in shreds of toilet tissue carried down nearly to the small ice house on the main brook. It is obvious that at this time, as well as during showers, this sewage is a serious menace to the safety of the water supply. A septic tank should be constructed as early as possible.

Quality of Supply as Indicated by Analysis.

Laboratory examinations have been limited as a rule to one or two samples only each year—a number in this case insufficient to serve as an accurate guide to the quality of the water at all times. From such analyses as have been made, it is apparent that its character fluctuates widely. As a rule, the content of organic matter is low, and with few exceptions this is also true of the color, so that were it not for such rather frequent physical characteristics as turbidity and earthy or vegetable odor, the supply might be regarded as excellent. Undoubtedly the normal quality of the brook water is good.

Recommendations and Suggestions.

While it is very apparent that the system in its present state is, much of the time at least, supplying a poor quality of water physically, and one which under the circumstances noted is necessarily possessed of a certain element of danger, yet it is not possible without further study to state just how the remedy should be applied.

Filtration at the Reservoir.

Were conditions altogether favorable thereto, there could be no doubt that the best remedy, all things considered, would be in the installation of a filter plant at the reservoir. This would satisfactorily care for the turbidity, and also, if properly conducted, counteract the danger on the pond above. At the same time, it cannot be emphasized too strongly that even were such a plant installed, every possible means should be taken to correct the conditions referred to.

It would seem, however, that there is not sufficient room along the brook for any proper filter construction, allowing for filter beds in duplicate and a clear water reservoir of adequate size for fire protection, and the latter at the same time so arranged that the excess brook water shall be excluded. Not only should there be provision for taking one of these filter beds out of commission for cleaning at short intervals, but the matter

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of roofing should be considered, unless, as at Franklin, the bed area is so large—involving relatively low service demands—that winter cleaning and removal of ice could be dispensed with.

While the mechanical system of filtration would undoubtedly be somewhat better adapted for handling the turbidity conditions and on a pumped system would probably be in all respects the most suitable, yet this system requires daily attention—something which would add greatly to the expense of operation of a gravity system. However, it should be understood that any system of filtration, to be worth while at all, would demand much more attention than the superintendent is at present required to give this supply, and incidentally it may be well here to emphasize that no consideration should be given to any makeshift sand-bed arrangement, such as has in the past sometimes been attempted elsewhere, with a view to a cheap short cut to water purification.

The feasibility of installing filters on the brook can be determined only following a study of the engineering features involved.

Extension of Present Pipe Line to the Pond.

It is urged that direct uninterrupted draft from the pond is not possible with the present cement iron pipe system, the extra 150 feet altitude involving an excessive pressure. However, it would not be impossible to arrange to pipe to the present reservoir and to conduct the brook water past the latter through a flume.

In my opinion, the argument that the aeration involved in the 150 feet descent in the brook flow serves materially to purify the water need not be given any weighty consideration. It is undoubtedly true that such aeration must serve to some extent for the elimination of any odors that might possibly arise as a result of growths in the pond, and to this extent retention of the brook flow feature is desirable, though by no means indispensable or of so much importance as supposed.

But while direct draft from the pond would serve to eliminate at least the greater part of the turbidity, yet the present sanitary conditions about this pond are such that in order to afford an entirely safe and satisfactory supply, the installation of some form of purification would be essential. Admittedly, a better course—and one which in any event ought ultimately to be followed out—would be the purchase of all of the objectionable watershed property. And herein comes one of the advantages of municipal over private water supply ownership. While it would be feasible for the precinct eventually to acquire at least most of the objectionable property, while the precinct could well afford to conduct its supply without any regard for dividends, and could rest satisfied with such merely paying for itself and for maintenance, in the case of private ownership, obviously dividends must be maintained, and no private interest is likely therefore to incur any extraordinary expense for improvements, if the cost of such is calculated to materially reduce profits for a term of years.

One of the modern forms of chlorination treatment, designed to

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provide for uniform dosage under irregular pumpage or delivery might be installed and operated at relatively small cost, either at the pond or the reservoir. In the latter place, while such would serve to sterilize the supply and render it quite safe, it would in no wise solve the problem of turbididty.

In conclusion, reference may be made to the urgent need in a village the size of Lisbon precinct, of some person who shall serve in the capacity of sanitary officer. It is my understanding that at the present moment there is no one charged with looking after the great variety of matters of this character which must arise in the course of the year. In these days, something else than a more or less nominal board of health is required. As showing the situation at Lisbon, there is apparently no regular oversight whatever of this kind as regards the water supply, and concerning certain minor nuisances which the superintendent himself had at times detected, such person seemed to have no idea of how he should act or to whom he should go in order legally to secure their abatement.

The superintendent suggests that regulations* should be issued for the protection of the purity of the pond water. In view of the conditions, I believe this would be a proper request, irrespective of what plans for purification may be adopted.

Respectfully submitted,

[Signed] CHARLES D. HOWARD,
Chemist.

APRIL 4, 1914.

HANOVER, N. H., May 15, 1914.

Messrs. B. S. Webb,
G. C. Brummer,
E. O. Crossman,
Special Commission on Water Supply,
Lisbon Village Precinct, Lisbon, N. H.:

GENTLEMEN—In accordance with your request under date of May 6, I visited Lisbon on the 8th to look over the situation which the existing water supply presents as affecting the public welfare.

Having already received and duly considered the report of Mr. Charles D. Howard, dealing chiefly with facts and observations which affect the sanitary conditions of the case, it was understood that I was called upon to give special attention to the engineering aspects of the problem; and if it seemed feasible, to suggest improvement of both sanitary conditions and structural features of the system.

It goes without saying that the single aim of all concerned should be to find the essential facts and from them to determine the right procedure without regard to personal prejudices or personal interests. The writer, being an entire stranger in the community and having no personal bias, has endeavored to view the situation impartially, and to make suggestions according to the evidence.

*Such regulations had previously been adopted under date of July 17, 1906.

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Inspection.

In company with two of your committee a visit was made to the "reservoir"; thence the brook and adjacent highway were viewed as far as the outlet from Pearl Lake, which was examined closely. Trips were made up the roads on both sides of the lake, and the location of all habitations and other structures noted. The Jessman farmhouse was visited to note the conditions of drainage by the brook, which flows past the rear door of the buildings and down into the main brook, below the lake. The drainage conditions from the Lake View House were also observed.

In the afternoon Mr. Gowing, of the firm of Gowing and Chamberlain, courteously granted an interview and answered questions regarding the pipe system, hydrants, etc. Mr. Chamberlain, the superintendent of the works, was reported to be out of town,—not expected to be home until July. Mr. Moulton, the owner, was also reported to be out of town.

In company with one of your committee a test was made of five hydrants at widely separated localities. The pressures were observed, by means of a Standard "test gauge" made by the American Steam Gauge and Valve Manufacturing Company, such as is used by the inspectors of the Associated Factory Mutual Insurance Companies in testing the fire-protection systems of mills all over the country.

It is proper to state also that in the time at command it was not possible to study details closely or make very precise measurements. Altitudes between the village, reservoir and lake were observed by a standard aneroid barometer. The readings, corrected for temperature, are believed to be correct within five or six feet.

Just at this time conditions are probably at their best,—snow and ice gone, streams in medium stage of flow, roads settled and free from dust, and all surface conditions showing the fresh and cleanly aspects of late spring.

Collection and Storage of Water.

The storage basin is Pearl Lake, with a tributary drainage area of four to five square miles by guess from "the lay of the land" and volume of the outflowing stream. The outlet is about two miles from and approximately 390 feet higher than Lisbon Main Street, where the brook road joins it. The description of the lake and its vicinity as given by Mr. Howard was verified in all particulars. We may add that on the hill-slopes and brook-courses draining into the lake are at least ten farmhouses and their various outbuildings, seven summer cottages near or close to the edge of the lake, one ice house on the lake margin and one along the roadside not far below the lake.

The stone barrier or low dam at the outlet of the lake has a cheap and even primitive arrangement for drawing water from the lake when it ceases to flow over the dam. A gate is set in the masonry less than four feet deep (judging by the length of the gate handle which had been carelessly left on the ground ready to the hand of any meddler who might choose to tamper with the fixture). Mr. Gowing stated that when the

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lake level sinks in a dry time it is necessary to trench the water to this outlet. (A proper outlet *basin* should have been made at this point when the works were built.) At this time a stream of about 2,500 gallons per minute, by estimation, was flowing over the dam, where driftwood had collected, some of which was decaying and therefore affecting the quality of the water injuriously.

From the lake outlet the brook flows a mile, in descending about 150 feet, closely alongside the road. It receives the drainage directly from the Jessman farm buildings. Mr. Jessman claims that these are on a gravel terrace and that all house drainage soaks immediately into the ground, but the brook flows behind the house, through the cow yard where cattle droppings were thickly scattered; and even some distance below, what was evidently soapy sink water stood in the little pools of the brook. The drainage from Lake View House flows directly down to the roadside at the lower ice house and thence in the road ditch to join the Jessman brook.

The "reservoir," so called, is simply a catch-basin which must collect whatever comes down the brook,—muddy water, gravel, leaves, driftwood, fish, etc. Its capacity, by estimation, can hardly exceed half a million gallons, *if kept cleaned out.* It regulates the "head" under which your system operates; but its storage capacity is small, especially in winter when the ice is from two to three feet thick.

As to the brook again, the aeration which the water receives in flowing a mile and falling 150 feet is only slightly beneficial, as Mr. Howard states. But the brook is exposed throughout this mile to trespassers (both man and beast); to matter carried by wind or washed by rain from the road surface; and to the drainage from the Jessman buildings and Lake View House. Right here some may have to be reminded that dangerous or contaminated water does not necessarily have a murky look. The murky or muddy water of western rivers is all that hundreds of communities have to drink, and may be quite healthful. The bacteria or germs of disease are colorless and so minute that only a man very expert with the microscope can detect them. Badly infected and dangerous well water is often clear and sparkling.

Comments and Recommendations on the Collection Area.

Mr. Howard remarked that: "The sanitary conditions observed, following a complete circuit of the pond, are to be classed as poor." The writer would say that this states the case very mildly indeed. There is great danger of contamination that may cause disease and death in your village. To show what are the possibilities the writer quotes from his report to the Water Commissioners of Claremont, N. H., in December, 1909, on pp. 156-7, N. H. Reports, Vol. 21.

"If there are any who would say that such a policy is prompted by mere fastidious theory, or the newfangled notions of 'sanitary cranks,' let them consider the following facts:

"The Windsor (Vt.) epidemic was not very far away nor very long

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ago. There was a case of typhoid fever on a hill farm four miles or more distant, and in the winter time. The infection (typhoid bacillus) from dejecta was washed down the brook into the storage reservoir just above the village. The entire water works system was infected. Hundreds contracted the typhoid fever and many died. There was the usual investigation and report after the mischief was done; the system was pronounced unsafe, and a new source of supply had to be found.

"The circumstances of the epidemic in Plymouth, Pa., in 1885 were quite similar. There were three small reservoirs fed by a mountain stream, along or near which were a very few houses. A man from one of these houses went to Philadelphia and contracted typhoid fever. It was a bad case and the man was sick many weeks. The dejecta were thrown upon the snow and frozen ground and washed into the upper reservoir when the spring thaw came. It happened that on March 26th the superintendent had to thaw out the pipe leading from the upper reservoir to those lower down. The first typhoid case appeared in town on April 9th; after April 12 from 50 to 100 cases appeared daily, and in one day 200 new cases were reported. Out of 8,000 people 1,104 had the disease (almost one in seven) and 114 died. Thus the origin of all this sorrow and desolation proved to be miles away on the mountain side, and it appeared that the typhoid bacilli retained their virulence after lying many weeks in frozen fecal matter and after coming some miles down stream in ice cold water.

"The New Haven epidemic in 1901 is equally instructive. A part of the city is supplied from Dawson Lake on West River, five miles distant. About a mile and a half above the dam a small stream flowed into the river, and about half a mile up this stream was a farmhouse, in which occurred several cases of typhoid fever during January and February. The excreta were thrown into a shallow privy vault without disinfection; this vault was 325 feet from the brook and 40 feet above it. On March 10th and 11th came a heavy rainfall of 2½ inches. Although the lake covered sixty acres, and contained 300,000,000 gallons, it was quite turbid on March 11th. About ten days later the epidemic began in the district supplied by Dawson Lake, *seven miles* distant from the source of infection. During April, May and June 514 cases occurred, resulting in 73 deaths.

"The Ithaca (N. Y.) epidemic of 1903, for the time being practically broke up Cornell University. There were 1,350 cases in a population of 13,156, or more than one sick in every ten. More than 500 homes were visited and there were 82 deaths. There were 3,000 students, hundreds of whom left town, some ill with the disease; these doubtless scattered the disease elsewhere. One episode of the epidemic is worthy of special mention, namely a secondary outbreak which resulted from the infection of a well. This well had been popular among students of a certain district at the time when the public supply came to be distrusted, and its quality was taken for granted. But the wife of the owner was taken sick with typhoid fever during the epidemic, and her dejecta passed without disinfection through the water closet, and into a drain pipe which ran within three or four feet of the well. The joints of the drain pipe were not tight, and the well water which had probably been for some time grossly con-

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taminated, finally became infected. As a result, about fifty cases of typhoid fever and five deaths were traced to people who used the water of this well.

"In the Scranton (Pa.) epidemic a reservoir containing one billion four hundred million (1,400,000,000) gallons became infected, so that during December, 1906, and January and February, 1907, 1,155 cases of typhoid fever were reported and 111 deaths.

"The sad experiences of Littleton and Woodsville in this state and St. Johnsbury, Vt., under somewhat different conditions, all teach the same lessons of the prime necessity of safeguarding and vigilantly watching the sources of supply."*

Looking at your situation in the light of all these facts, any candid and well informed observer would say that your water system lacks even the most elementary and obvious safeguarding. Now your local board of health may and ought to apply to the State Board to promulgate the usual "Regulations" for the protection of your water supply. But that is not enough. The most alert and efficient local board cannot be sure of continued obedience to the rules. A special inspector appointed and paid to see that prescribed sanitary conditions are maintained throughout the district would be more effective. But even he cannot watch everybody every minute. Hence I would recommend the following measures as the first and most direct and necessary:

1st. Prohibit all boating (and bathing of course) on the lake. Fishing might be allowed by permit at stated times and under restrictions by your health board.

2nd. Remove all buildings (excepting the ice house) between the margin of the lake and the roadway. As long as summer cottages and boathouses remain close to the water, anything disgusting and injurious to your water supply may happen, in spite of regulations.

3rd. The Jessman brook and all other flow from north of the road and from the road itself, including that from Lake View House, should be kept on that side; and all culverts under the road filled up between the reservoir and the lake. Then if these places cause any nuisance along the roadside, it will be manifest and subject to action by your board of health. This making of a roadside channel would be inexpensive, requiring only enlargement of the present ditch and extension to a point below the reservoir dam. It might require two or three lengths of corrugated culvert pipe to pass beneath the bars which at certain points had better be extended into the hillside (the drainage from the bars being always into the ditch), also a few sticks of dynamite to cut away obstructing ledges at some points; and a few days of labor altogether to complete the grading and surfacing. This would simply come under the head of ordinary road-repairs in the tax levy. Such work, being for the protection of the water supply, is a matter of *the first public importance to a majority of the town of*

*Reports of New Hampshire State Board of Health, Volume 21, 1909–10; facts given by George C. Whipple in his book on Typhoid Fever. John Wiley & Sons, New York. This should be in the town library and read by all public-minded citizens.

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Lisbon, regardless of the ownership of the water works; and that majority ought to require that it be done and done promptly.

4th: "The reservoir" should be fenced in by a fence "horse high, bull strong, and pig tight." The writer has seen such a fence in Montana, built without any posts, by use of X frames, and will send you a sketch if called for. So much protection is needed as a mere matter of prudence. Stout square mesh (sheep fence) covered by closer mesh (poultry fence) would deter trespassers, keep out quantities of leaves and arrest drift-wood, etc., brought down by the brook. That there is need of this is shown by the reported troubles with your pipes and my own experience in testing the hydrants, when quantities of leaves were blown out through the nozzles. It is much to be desired that trees growing close to the margin should be cut so as to lessen the chances of leaves falling into the stored water.

5th. Householders throughout the district tributary to the lake should be required to take care of their house drainage on their own premises, according to rules and suggestions heretofore made by the State Board of Health. The primitive privy vault should be replaced by some form of sanitary closet (like the dry earth closet, or septic tank if water is freely used)—as described in the N. H. Sanitary Bulletins of July, 1905, and January, 1911,—to be had free by applying to the writer or to the Secretary of the State Board of Health, Concord. Farmers should be requested not to place manure so that the leachings will run off frozen ground into the lake. *Self-interest* ought to deter them from such practice.

6th. Eventually, if possible, the village should acquire ownership of a margin around the lake at least five rods in width, and from that up to twelve rods or more.

These precautions are imperative and all, excepting the second and last, practicable without much expense.

The complaints as to the quality of the water have been noted in Mr. Howard's report, and also the explanations given by Mr. Moulton and Mr. Chamberlain. As to the turbidity being due to erosion the writer saw little evidence of erosion along the road side. And the opposite bank of the brook appeared to be generally rocky and the stones moss-covered (also abounding with leaves ready swept into the brook by rain or wind). If the log protection mentioned in that report has proved inadequate, certainly a stone protection should be made sufficient for the purpose. In this stony region there is no reason to tolerate eroding banks when a remedy is so simple and inexpensive. That these conditions have been allowed to remain so long seems to be circumstantial evidence that there has been carelessness and neglect on the part both of the public and the owner.

A *seventh suggestion* is this: In October, after the leaves have fallen, leaves and dead-wood should be raked away from the margins of the brook and reservoir, and burned. This has been our practice about the Hanover reservoir and tributary brooks. The cost is not great and the benefit considerable.

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The Pipe System.

The original main pipe system was laid with cement-lined pipe, which Mr. Gowing says has proved entirely satisfactory, being strong enough under the service pressure as it is, always clean whenever opened, and apparently as good as new after more than thirty years of service. But subsequent alterations and extensions have been made with standard cast-iron pipe. This, he says, has given trouble by rusting so rapidly that in some places they have been obliged to renew it.

As the writer has had experience with cast-iron pipes which have been in use in the Hanover Water Works twenty years, and have shown very little rusting (a piece of 8" pipe removed to insert a branch had but few rust spots about the size of apple seeds), he ventures to suggest that if the quality of the pipe used in Lisbon was not of the best, especially if the interior was not thoroughly coated with the best protective coating, the rapid rusting was to be expected. Mr. Allen Hazen, a high authority, says in his book, "Clean Water and How to Get It," (published by John Wiley & Sons, New York. Quotation from pages 59 to 61):

"The way that the process of tuberculation goes forward seems to be something like this: The water flowing, at times slowly, and carrying matters in suspension, deposits some of these suspended matters on the lower half of the pipe. This deposit usually contains a considerable amount of organic matter.

"The iron pipe is coated with tar or asphalt. If this coating were perfect or complete, the deposit would not come in contact with the iron at any point. But there are always blowholes or other minute openings in the coating, and it is through these that the iron is first reached.

"The organic matters in the deposit over the iron are in a state of decomposition; that is to say, they are rotting. This results in the generation of carbonic acid. The carbonic acid acts on the iron through the openings in the pipe coating. It takes some of the iron into solution as ferrous carbonate. The soluble ferrous carbonate diffuses through the water, penetrating the deposit under which it is formed, and reaching the upper surface of it, where it comes in contact with the water flowing in the pipe. A part of the iron mingles with the water in the pipe and goes forward with it. Another part, becoming oxidized by the oxygen in the flowing water, is transformed to the insoluble ferric condition and remains at the surface of the deposit.

"The iron precipitated in this way acts as a coagulant. It coagulates some of the organic matter in the flowing water at the point where the iron is precipitated. It binds the organic matter so precipitated, and that previously deposited, into a firm, compact, but porous mass, and this mass is the beginning of a tubercle.

"The organic matter precipitated by the iron at the surface of the tubercle is so much fuel added to the flame of decomposition, and the carbonic acid resulting from it leads to the solution of further quantities of iron. In this way the process becomes a continuous one.

"The circulation of the liquid through the tubercles, taking the car-

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bonic acid to the iron and bringing the iron to the surface, is very slow, and many years may elapse before the tubercle reaches the height of an inch.

"Tuberculation is practically universal in cast-iron water pipes, but some waters cause the action to go forward much more rapidly than others. Tuberculation starts much more freely, and progresses more rapidly, in waters from rivers or reservoirs containing suspended organic matters."

Since the Lisbon water contains not only *dissolved* organic matter usual in surface water but also quantities of leaves which have been allowed to enter the pipes where they must decay, the conditions described by Mr. Hazen are complete and extensive in this case for producing rapid decomposition and tuberculation in the iron pipes.

Tests of Hydrants.

The first one tested was that near the dead end of the line past the schoolhouse. Upon one hydrant opening was attached a short pipe nozzle in which was inserted a standard (Sanborn) gauge-plug, to which the pressure gauge was attached. To the other hydrant opening, one of the flexible 1″ pipe nozzles was attached. At first mud and leaves came out freely during two or three minutes. Also the small nozzle holding the pressure gauge caught four pebbles about the size of large marrowfat peas; also at one time pieces of leaves choked the passage to the gauge which had to be removed and relieved. Here the static pressure was 60 pounds, but with the nozzle in operation the pressure was 10 pounds. This was practically the pressure at base of a 1″ playpipe, which by Freeman's tables would indicate a discharge of 93 gallons per minute, through a smooth conical brass nozzle. But this was a flexible nozzle not smooth, and the actual discharge may have been only about 85 gallons per minute. Here is a loss of 50 pounds pressure or about 115 feet head from pipe friction. Some say this dead end has several hundred feet of 4-inch pipe, old and rusty; others say it is only 3-inch pipe. The friction loss for even two streams, or twice 93 gallons per minute, would be, in the entire main line of 8″ and 6″ pipe, less than 12 feet; hence more than 100 feet of head, equal to about 44 pounds per square inch, is lost in the four inch or smaller main. Whatever may be the length of this part, the tables show that only two streams, classified as "feeble" by Freeman, might be had through 400 feet or more of hose for each one. As *effective* streams they would probably reach less than 30 feet horizontally and less than 25 feet vertically.

At the schoolhouse hydrant the static pressure was 62 pounds, and this dropped to 17 when the stream was turned on. This would allow a little better service, chiefly because the hydrant is so near the house that a length of 250 feet would probably be sufficient. But at best the one or two streams would still be classed as "feeble." It appears from these figures that the region about those two hydrants does not have adequate fire protection.

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We may remark here that Freeman's tables are based upon very careful experiments made at Lawrence, Mass., in 1888, alongside high mill buildings where accurate measurements of throw and height of streams were made, and the water collected and measured in a tank. They are accepted all over the world by underwriters, by the American Fire Protective Association, by municipal authorities and others; and hose pipes, nozzles and other equipment are now standardized to agree with Mr. Freeman's tests.

The next hydrant tested was on the same street, at the James Richardson house. This showed 70 pounds static pressure and 38 pounds with the nozzle discharging. Under these conditions it would discharge about 170 gallons per minute through one line of hose, with a throw of 50 feet; classed by Freeman as a "good" ordinary fire stream."

These three tests show that the street main west from Richardson's is all too small, and that it is hardly large enough even there to serve houses 500 or more feet distant. And here we may remark that the hydrants are too far apart. The distance between them should not exceed 600 feet, preferably less. No single hose line at a fire should be over 500 feet long, and of this 100 feet or *more* may be needed to close about the premises. It is a good maxim that "hydrants are cheaper than hose," because the latter is constantly deteriorating and needs continual outlay. This is a good doctrine for the *precinct;* but, with private ownership, the other party might disagree. Moreover, firemen do not realize how much every additional 50 feet of hose cuts down the pressure. Freeman's experiments showed that if a certain stream can be furnished through 50 feet of hose it would require double the hydrant pressure (dynamic or "running" pressure) to serve an equal amount of water through 600 feet of hose.

Furthermore it is a mistake to lay any street main with less than 6" pipe, where hydrants are to be served. Especially true *near a dead end.* In special cases, where the pressure is high, a very few hundred feet of four-inch pipe might be allowed. For instance, to get 320 gallons per minute through 500 feet of 4-inch pipe would entail a loss of about 37 feet of head by pipe friction, and *that* in *clean* cast iron 4-inch pipe; this loss of head may be doubled after 20 years of use *if* the pipe rusts badly (according to Hazen).

Two tests were made on Main Street. At the southwest end the farthest hydrant showed 90 pounds static pressure and 25 pounds running pressure, with only the inch nozzle attached. This very large drop of 65 pounds for only a 1-inch stream shows great loss by friction. This would give rather poor protection to Parker and Young's lumber yard if a fire there should get under much headway under a strong wind. The nozzle alone probably discharged about 140 gallons per minute. With two 500 feet lines of hose the streams might carry 40 feet more or less, and would be classed just beyond "feeble," as fair, ordinary fire streams."

At Hibbard's the static pressure was 98 pounds and running pressure 75 pounds. This pressure maintained at the hydrant would probably deliver 250 gallons per minute through 200 feet of hose and the 1-inch nozzle. We need not say that this region on the main line has the best of protection.

I was informed that Parker and Young have three or four hydrants of their own within their premises. In case of a real conflagration (of which there is serious liability, according to the saying: "That which *may* happen,

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will happen, sooner or later") it would be necessary to use all of the hydrants, including the one in the street. This calls for about eight fire streams, of at least 125 gallons per minute each. Even if the 8" main extends down to the premises and well beyond the office, you could not get so much water (1000 gallons per minute) delivered. Assuming that main to be 9000 feet long, over 180 feet of friction head would be developed in the main line alone, as the velocity in the main would be nearly 6½ feet per second. The hydrant connecting pipes being all 4-inch, these with some few hundred feet of 6" pipe would probably more than consume the remaining 70 feet of head, and besides that is the friction in 1600 to 1800 feet of hose (225 feet per stream) which would alone have a friction head of at least 50 feet. At the very best the streams would all be "feeble," unless only 2 or 3 hydrants (giving only 4 or 5 streams) were tapped at once.

Where so much is at stake, not only for Parker and Young but also for the entire village, it would be a wise precaution to make an emergency test to see what is the utmost delivery that can be had at the "dead end." This might be done at the time of a general testing of the hydrants which should be done at least *once* a year, and preferably every spring and autumn, to blow out the mud and "prove" them. This is now not systematically done (by report). This is imperative for hydrants at dead ends. "It goes without saying" that in the layout of street mains the sizes are determined by the demands made upon them for fire streams in emergencies. Much smaller mains would suffice for the house services. It is for that reason that 4-inch mains should be used very sparingly. For instance, a *new* and *clean* 4-inch main 1100 feet long, delivering only 250 gallons per minute, giving only two ordinary fire streams would cut down the hydrant pressure 22 pounds or use up 50 feet of head. If moderately rusted these figures might be 50% greater.

If the precinct owned the water works it would be worth while to connect the two southwestern dead ends by a 6-inch main laid under the river. This would give free circulation in the *loop* and very much improve, not only the hydrant service, but also the house service, because dead ends collect the sediment in the pipe. Of course a proper blow-off gate and extension would be placed at one of the river banks.

In this connection it is proper to suggest that there should be in the office of the superintendent, or other convenient place, an automatic recording pressure gauge which would keep a continuous record of the static pressure on the system, note any unusual variations of pressure, and might lead to detection of unauthorized uses; and would tell the true story of the pressure fluctuations when there is a fire. The cost would be sixty dollars, more or less, for purchase and installation.

Some Larger Considerations.

Especially if Public Ownership is Possible.

Assuming that Lisbon is a growing place and has a policy of expansion for the future, the water works need enlargement and improvement. My information is that a shortage occurs every two or three years, and that the use has to be restricted; also that much water is wasted, due to neglect and lack of proper supervision.

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Your lake, for its size, is rather shallow; certainly much of the margin is shallow. Your intake being placed in a natural barrier is not deep enough, as I understand it, to draw any water from lower than a very few feet below the full level. A low dam, five or six feet high, built across and over the present outlet would probably *more than double the storage capacity* of the lake, that is the *available* capacity as compared with that at present. This dam would have to be long, and might require some change in the roads.

Furthermore, all uncertainties and trouble about the brook course would be avoided by laying a 6" main from the lake to the "reservoir," with a gate, of course, at the lake outlet to regulate the flow. The distance being about a mile, the cost of this would be probably $2,200, more or less, for the pipe, and about $1,300 for hauling and laying, or $3,500 for the pipe line alone. This supposes the pipe to be laid in a trench about 4 ft. deep along the roadside which would be necessary in our climate. A four-inch main would suffice if it would keep clean.

Some simple construction for improvement and regulation at the "reservoir" is desirable, but this is not the time or place to go into detail. A close estimate of the entire cost of such improvements could only be given after a suitable survey.

Concerning the water channel or ditch on the north side of the road,—if it is made,—those who have it in charge must bear in mind that a very considerable amount of water will come down there in time of a heavy rain. It should be at least *two feet* wide *on the bottom,* and eighteen inches deep and paved with stone in soft spots. It must take the drainage of more than 200 acres, for a guess, but on that grade the water would flow very fast.

Finally, your continued troubles with leaves and, as I am informed, with fish of considerable size caught in your hose pipes and dead ends, is evidence that the screening is inadequate. (The improvement at the reservoir referred to would include a standard gate-chamber with double screens of considerable vertical height.)

An obvious immediate remedy is a set of two movable *cage screens,* placed tandem, so that one can be raised and cleaned, leaving the other in place. And anybody ought to know that such screens need *frequent attention,* as in case of water-wheel screens.

And again it goes without saying that you cannot have satisfactory operation of such a public utility without painstaking care and intelligent interest for the public welfare on the part of at least one *responsible, well informed* and *well paid* officer or employée.

Respectfully submitted,

ROBERT FLETCHER,
President and Engineer of
Hanover Water Works Co.,
President of New Hampshire State
Board of Health; Consulting Engineer.

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WEST LEBANON.

The Hartford Water Company, of White River Junction, Vermont, supplies water also to the village of West Lebanon. During August, 1913, it became necessary to utilize other than the regular sources of supply. In this connection, Mr. Howard's report, under date of August 28, is as follows:

This company, which is affiliated with the Mascoma Electric Light & Gas Company, furnishes water to both the villages of White River Junction, Vt., and West Lebanon, N. H., the system being a gravity one, consisting of three reservoirs, formed through the impounding of spring and brook water. These sources, located in the hills a number of miles back from the village, were not visited by me. The superintendent states that there is no cultivated land on the watershed at present, all of the farms having been purchased by the company, and that there are no probable sources of contamination.

The total available storage is stated as being about 10,000,000 gallons. On account of the drouth, the volume of water has so far diminished as to have become a matter of concern to the company, and it is claimed that an emergency exists warranting immediate action looking toward additional sources of supply for West Lebanon.

It was pointed out that the Company's charter, granted by the State of Vermont, gives the company no authority to furnish water in New Hampshire, and that in the event of a serious shortage, endangering the welfare of the citizens of White River Junction, such company could be legally restrained from disposing of any part of its supply to its New Hampshire consumers. The Company has about 250 water takers in West Lebanon, the daily consumption being estimated as approximately 50,000 gallons.

Sample No. 11447, forwarded by the Company, was stated to have been collected from a spring. The analysis follows:

Spring, proposed source of supply for West Lebanon.

Odor	Foul
Color	.20
Turbidity	None
Sediment	Sl. coarse
Free ammonia	.0030
Albuminoid ammonia	.0030
Nitrates	.010
Nitrites	High
Chlorine	.38
Hardness	5.6
Colon bacilli	Doubtful

The above spring was found to issue from a deep, winding ravine at a point about 100 feet from the river bank on the New Hampshire side, and

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slightly less than a half mile above the main sewer outfall. The ravine traverses an intervale, at one point reaching within a short distance of a set of farm buildings. The land to the east consists of high hills, with woodland and pasturage. There is also what is said to be an abandoned slaughterhouse located on the intervale a few rods from the ravine. However, under ordinary conditions, the only chance for contamination reaching the latter from either place mentioned would be by percolation. Both locations will, however, bear watching.

As the analysis indicates, this water is contaminated at the spring at present, as a result of cattle drinking there. This, however, is a matter that can be easily and satisfactorily remedied. With proper care at the spring, there is apparently no reason why this water should be other than of acceptable quality. The flow, which discharges directly into the river, has been found to be approximately 16,000 gallons daily.

The other sample, No. 11445, taken from the Connecticut River at a point near the New Hampshire side and immediately opposite the spring, gave the following analysis:

Water from Connecticut River about one half mile above White River Junction.

Odor	sl. earthy
Color	.45
Turbidity	v. slight
Sediment	sl. flocc.
Free ammonia	.0026
Albuminoid ammonia	.0110
Nitrates	.003
Nitrites	.000
Chlorine	.05
Hardness	4.0
Colon bacilli	Positive

This river receives more or less sewage from the towns on either bank for many miles above, the nearest sewer outlet of any size above being that of Hanover.

The quality of the water at the present time, as regards color and organic matter, is not so good as that of the Ammonoosuc River supplying Woodsville above. However, the Company's superintendent hastened to disclaim any intention of drawing direct from the river without purification. I was informed that arrangements had already been made looking toward the early installation of a system of rapid filtration, a battery of filters of the closed, or pressure, type being under consideration. It is represented that such a plant would probably be needed each season during from three weeks to three months, and the plan was to put in a steam pumping plant with a total daily capacity, using both spring and river water, of about 100,000 gallons. This water would be pumped directly into the mains on the New Hampshire side, which arrangement would necessarily involve some intermingling of both supplies on either side of the river.

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While rapid filters, using coagulant, would be most suitable for treating the river water under the conditions involved, the advisability of employing the pressure type might be questioned. The latter are primarily designed for private or individual use, and though very convenient and easily installed, for municipal filtration they are more expensive as well as less desirable than filters of the open or gravity type, such as are in use at Lebanon, Exeter, and Berlin. The latter are necessarily more accessible and their efficiency more readily and surely controlled.

Attention was called to the hypochlorite treatment, and the desirability was suggested to the superintendent of installing a moderately permanent equipment for this purpose providing for treating the combined river and spring supply—not only for any possible emergency pumping prior to the installation of the filters, but as a regular auxiliary to filtration. This, I was advised, the Company would undoubtedly put in.

It being evident from samples submitted that the process of filtration of river water was not proceeding satisfactorily, on November 29, 1913, the chemist of the board visited West Lebanon for the purpose of noting the character of the plant in use. His rpor follows:

Dr. Irving A. Watson,

Secretary, State Board of Health:

DEAR SIR—The following facts are submitted relative to the new source of supply of the Hartford Water Company for West Lebanon.

This supply is at present pumped from the Connecticut River, passed through a system of two rapid filters, the filtrate treated with hypo and discharged into an earth basin which also receives the water of a spring. The mixed waters, thus treated with hypo and amounting in all to 70,000-75,000 gallons daily, are pumped into the mains, the excess going into the Company's reservoir on the Vermont side.

Chemical analyses of samples taken November 11, 1913, shortly after operations were commenced, afforded results as follows:

ANALYSIS OF WATER FROM VARIOUS SOURCES.

West Lebanon Supply, November 11.

Data	River 11944	Filtered only 11945	Filtered and Treated mixture 11946	Tap in Village
Odor	Earthy-Vegetable	Earthy-Vegetable	Sl. veg.	None
Color	.35	.32	.25	.25
Turbidity	consid.	mod. opal	mod. opal	consid.
Sediment	mod. gray flocc.	v. sl.	sl. flocc.	Consid flocc.
Total residue.....	6.0	5.9	8.3	7.2
Fixed residue.....	4.7	4.0	6.6	5.5
Free ammonia.....	.0010	.0008	.0026	.0022

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Data	River	Filtered only	Filtered and Treated mixture	Tap in Village
	11944	11945	11946	
Albuminoid dr.....	.0120	.0130	.0140	.0120
Nitrates	.003	.0030	.005	.005
Nitrites	.000	.000	.000	.000
Chlorine	.11	.10	.23	.20
Hardness	2.4	3.2	3.5	3.6
B. coli	X	X	X	X

X Positive.

The above indicates practically nothing accomplished as a result of the attempt at purification, there being practically no reduction in color or proportion of nitrogenous organic matter, and colon bacilli being present throughout in 1cc.

However, the plant was new, and good results could not be looked for at once. The next lot of samples collected for regular analysis, on November 25, showed:

Analysis of Samples collected November 25.

Data	River No. 11789	Filtered Only No. 11791	Filtered and Treated No. 11790
Odor	Earthy	ft. earthy	Earthy
Color	.40	.06	.08
Turbidity	sl.	v. ft. opal	sl. opal
Sediment	sl. coarse	v. sl	sl. flocc.
Total residue	7.0	6.8	9.0
Fixed do.	4.0	4.8	6.5
Free ammonia	.0010	.0008	.0008
Albuminoid do.	.0124	.0074	.0080
Nitrates	.003	.003	.003
Nitrites	.000	.000	.000
Chlorine	.10	.10	.20
Hardness	2.3	3.2	3.6
B. coli.	X	Negative	Negative

The above indicates much better work. Physically, the improvement as a result of filtration, is good, the color being reduced to a very low degree, and the organic content also reduced. No coli were found in 1c.c. of either the filtered, or filtered and treated samples.

Samples collected for bacteriological counts showed:

Source	November 17. Bact. per cc.		B. coli	
	Body Temp.	Room Temp.	1 c. c.	10 c. c.
River	10,000	25,000	X	X
Filtered only	8,000	21,000	X	X
Filtered and treated.....	10	1,100	—	—
Tap in village.....	3	125	—	—

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Source	November 24. Bact. per cc. Body Temp.	Room Temp.	B. coli 1 c. c.	10 c. c.
River	25,000	High	X	X
Filtered only	5,000	310,200	—	X
Filtered and treated	18	4,280	—	—
Tap in village	100	4,000	—	—

X Positive. — Negative.

The results of November 17 indicate but 20% of the bacteria removed by filtration. Results on the treated samples were satisfactory as a whole—excellent on the agar growths, although one sample gives a rather high gelatin growth. It is evident, however, that the dangerous varieties of bacteria are pretty thoroughly eliminated.

The November 24th samples indicate an exceedingly dirty condition of the river, bacterially. In view of this, the removals by hypo. are to be regarded as good, although the residual bacteria growing on gelatin are too numerous. The number growing at 37 C. is, however, well reduced. Bacterially, the filtered water shows up better than on November 17, at least to the extent that a large proportion of the 37° bacteria present are removed, although the residual is, of course, far too high.

The color removal was good, the raw waters reading 0.35 color, as against 0.05 for the filtered—i. e. practically complete removal.

It being apparent that, bacterially, the working of the filter is far from satisfactory, I went to West Lebanon on November 29, and found the following conditions:

The pump shed is located just under a high bank some 20′ above the river level and contains the battery of two pressure filters in addition to the high service pump. Water from the river is pumped to these filters by means of a small low service piston pump. Pumping is continuous during the 24 hours, the amount taken from the river varying from 50,000 to 60,000 gallons, this being augmented by about 15,000 gallons of spring water, the total daily pumpage, therefore, amounting to 70,000-75,000 gallons. This water traverses the mains of both villages, the excess going to the reservoir on the Vermont side.

The filters consist of two upright units of the closed, or pressure, type, connected in series—i. e. the water after passing No. 1, is conducted through No. 2 with a view to effecting further purification. No. 1 is filled with sand; No. 2 with animal charcoal. Immediately at the influent of No. 1 is the coagulant pot, there being therefore no opportunity whatever for sedimentation previous to entering the filter.

After passing No. 2, the effluent receives a dose of hypo. and is discharged into an open earth basin, which also serves as a reservoir for the accumulation of the spring water, the mixed waters being thence pumped into the system.

It is represented by the management that this is but a temporary plant and that with a few days of good rain it would be abandoned in favor of the regular supply. However, the latter has now been very low for a number

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of months, and the chances are that the present source will have to be resorted to for some time yet. This being the case, it is evident that certain changes in the present arrangement should be effected at once, in order that a dependable supply of reasonable purity may be furnished.

Fortunately, the company has not permanently acquired the filters. The latter, being of the pressure type, are not only undesirable for the end in view, but also in this case fail to serve one of the principal objects in their use, viz.; the avoidance of double pumping. Furthermore, they are much too small for the service demanded of them. The internal diameter is not more than 32", corresponding to an area of 5.6 sq. ft., i. e., to a minimum hourly capacity of but 672 gallons, or a daily capacity of about 16,000 gallons. Under the present arrangement it would not be correct to assume 32,000 gallons for the two filters, for the reason that No. 2 does not, properly speaking, act as a filter, but as a final clarifier. While it is true that under favorable conditions, the 16,000 gallon rate can be materially exceeded, with good results, yet the present maximum rate of 60,000 gallons is far beyond anything that could properly be expected of this filter, arranged as at present, even with the best of conditions.

In my opinion the No. 2 filter is at this time accomplishing but little. The only object in the use of charcoal is for brightening up the appearance —for removing the last traces of color from an already clean water. As a bacteria remover, this charcoal bed, under the conditions of use, is bound to be nearly if not quite, useless, and it should never have been employed in a situation of this character.

My recommendation would be that this charcoal bed be removed, and be replaced by one consisting of about 30"-36" sharp sand, underlayed by a few inches of gravel and pebbles. The system should then be connected up to work "in parallel," i. e., each to receive raw water simultaneously. By the present series arrangements, the coagulated material necessary to form the filtering film would be lacking in the second filter.

As to coagulation and sedimentation: The present absolute lack of any provision for the latter is a very serious defect and one that must be remedied by some means or other. By far the best arrangement would be to continue the raw water line from the point where the coagulent at present enters, direct to a tank or basin located on the bank immediately above the pump shed. This basin should be of such capacity that the water would consume at least one hour in its flow through it to the filters. It should be provided with baffles and an overflow dam over which the water would pass to the filters—also with an outlet and hose connections for washing out the separated sludge.

A much less desirable substitute for this, but one which might serve temporarily, would consist in the employment of a steam boiler or similar container, the water being conducted in a sufficient distance above the bottom and drawn off at the top to the filters.

At present these filters are washed as often as once in two hours, which is evident in itself, obviously, of the heavy load to which they are subjected. The bed is in a continuous state of disturbance, the interval between an overload on the one hand, and lack of "ripeness" on the other being very short. A uniformly pure filtrate is therefore impossible.

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I find that the coagulant tank is filled about every three days with 75 lbs. of alum, corresponding to 25 lbs. per day, or at the rate of nearly three grains per gallon. This seems like a rather heavy dosage until it was discovered that the compound in use was ordinary potash alum, and not the usual sulphate of alumina. The alum as purchased is said to cost about 3½c per lb. As it goes only about two-thirds as far as sulphate of alumina, this makes the cost, as compared with the latter, about 5c per pound, whereas sulphate of alumina is delivered in this state to the local R. R. station (Penna. Salt Mfg. Co., Philadelphia, Pa.) in 400 lb. bbls., at a cost of but $1.15 per hundred.

It may be pointed out that alum is a double salt, consisting of a mixture of aluminum sulphate and potassium sulphate. The latter not only accomplishes nothing in connection with water clarification, but represents so much additional chemical permanently contained in the water.

Hypo. Treatment. Thus far nearly the whole burden of rendering the water safe has fallen upon this agent. It is represented that a pound can is used a day to the 75,000 gallons treated (spring and river water). This would be at the rate of about 13 lbs. per million gallons, or a little more than .50 parts chlorine per million—a dosage somewhat larger than is employed in the average treatment, although nothing like up to the maximum which might be used.

As a matter of fact, I find that the cans of bleaching powder, marked "net weight 13 oz.," actually contained but 12 oz., correspnoding to a treatment of 10 lbs. per million gallons, and as this powder tests a trifle less than 29% (instead of 35%) the actual rate of treatment is but .33 parts chlorine per million—a very moderate rate. For the present, I would advise that the amount used be increased about one half—not more.

The present apparatus for applying the treatment is open to the criticism of being somewhat too crude to afford uniform results. This includes but one barrel, and there is no automatic means of securing a constant discharge. It is recommended that two barrels be added to this equipment, one for mixing, the other for reserve; also, that an orifice tank be connected as indicated in the Bulletin. At present, it is the practice to make up the hypo. solution while the filters are being cleaned. This does not afford proper time for settling, and means that there must either be a period while filtered water is not being treated, or else that the process is interrupted through the clogging of the valve by the unsettled solution. As it is absolutely essential that this vital part of the treatment be *continued uniformly and without interruption* during the whole 24 hours, it is evident that to avoid the expense of $50 or $60 needed to secure proper equipment would prove very poor economy. Even while the filtered water is not discharging into the basin, I believe it would be well to continue the flow of hypo. solution.

Attention may be called to the fact that the spring referred to is at the termination of a deep, winding ravine, which is not only used to some extent as a dump, but also receives a certain amount of sewage and farm drainage. Although this ravine is normally dry, during the spring freshets a large amount of water is said to come down, and this fact would neces-

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sarily involve, at such time, the abandonment of the present spring supply.

In conclusion, the recommendations herein contained may be summarized as follows:

(a) Provision for sedimentation, (b) Substitution of sand for charcoal in filter No. 2, and changing connections, (c) Advisability of use of aluminum sulphate in place of common alum, (d) Improvement of hypo. apparatus, (e) Extension of filter effluent pipe to a point close to pump intake and at about the same depth.

Respectfully submitted,

[Signed] CHAS. D. HOWARD,
Chemist.

CONCORD, N. H., December 1, 1913.

CONCORD.

Criticisms having arisen from certain sources relative to the purity of the Concord water supply and examination of conditions on the watershed was made during December, 1913, by the chemist of the board, the following statement being rendered to the local health officer:

Mr. C. E. Palmer, Health Officer,
Concord, N. H.:

DEAR SIR—Complying with your request I am handing you a statement of my opinion concerning the character of the Concord water supply based upon the results of analyses and following a tour of the watershed made December 18 in company of Superintendent Sanders and yourself.

First, as regards the quality indicated by analysis: Such examinations, as made from time to time, show no great variation in character. The results of analysis of a sample taken December 13 from a tap in the state house represent normal data for the season and are indicative of excellent quality for a surface water. Bacteria of intestinal origin are absent, the proportion of organic matter is not large, and the degree of color is extremely low—in this respect comparing very favorably with a good spring water. While a certain amount of odor is inseparable from a water in part of surface origin, at this time both odor and taste are practically unnoticeable. In short, so far as analysis can show, there is nothing whatever about this water likely to prove a cause of disease.

The condition of the shores at this time is excellent, and Superintendent Sanders deserves commendation for the improvements achieved during the past two or three years in the way of cleaning up along the water's edge. With the exception of a short stretch between the two school boathouses the Long Pond shore above the intake is free from mud and, on the whole, presents an attractiveness of appearance very seldom excelled and not often equalled in the case of any supply anywhere.

The situation as regards summer cottages has, as you know, undergone considerable improvement of recent years. There are still a few cot-

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tages remaining on the eastern watershed but no unsanitary conditions were noted. On the west side, the Holden cottage, because of its insular location, and the Young cottage present some rather undesirable features, although considering the location, the sanitary arrangements are as good as they well could be. While I believe that the likelihood of any direct seepage into the pond from these places is decidedly remote still there is no denying that the elimination of these cottages would be an improvement.

The same opinion might be expressed with regard to the large cesspool located on the state hospital cottage grounds. The presence of such repositories on the shores of a body of water constituting a public supply is certainly far from being an ideal circumstance, although as a matter of fact such endanger the purity of the supply to an infinitesimal degree only. In fact, the only time involving any actual danger whatever is during the process of cleaning out.

Nor is the actual degree of defilement resulting from boating, fishing, and surreptitious bathing much greater, if we consider the size of the body of water and bear in mind its natural capacity for self-purification through chemical and biological agencies. In short, all of these features are to be objected to almost, if not quite, as much from esthetic considerations as on account of any real likelihood of causing appreciable pollution.

The only condition noted really warranting an emphatic objection was in connection with the disposal of manure at the new Sunnyside Farm belonging to the State Hospital. The present arrangement is such that there is very serious danger under certain conditions of direct drainage into one of the principal brooks feeding the pond. It is stated that a promise had been secured that this condition would be corrected through the construction of a cemented retaining wall. Such should be put in without further delay.

Conclusions. There would seem to be no sound basis for any belief that there is any direct relation whatever between the present quality of the water and the prevailing sickness. And as regards absolute immunity from infection in general through the medium of water, it may be stated that those who choose to buy water by the gallon have no such immunity—although they may have physically better water.

The question has been raised if the State Board of Health, acting within its police powers for the protection of the public health has not sufficient authority to prohibit boating and fishing in the case of a body of water devoted primarily to the purposes of a public water supply, even though such pond does come within the classification of state property. It may be pointed out, however, that the establishing of such a precedent might later prove embarrasing in the case of such larger supplies as Lakes Winnepesaukee, Sunapee, and Canobie Lake.

Recognizing the principle that too great care of a city's water supply can scarcely be taken, and that no surface source derived from a populated watershed can ever be deemed absolutely safe the city may well, in my opinion, give consideration to the adoption of some one of the modern forms of sterilization treatment. Such a treatment, which is in line with

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that recently adopted by numerous other municipalities making use of a surface source, could be readily installed at a cost probably not exceeding one or two thousand dollars, and the operating cost would be almost negligible.

Not only would the water thereby be injured in no respect whatever but there would be a tendency to reduction of odors and tastes, as well as the final elimination of any possible likelihood of diarrhoeal infections from this source. It should be understood that this involves merely a question of desirability, not of necessity—yet considering the inexpensive insurance and the extra popular sense of security which the public service of a practically sterile water would afford, I believe that it would be well worth the moderate expense involved.

Respectfully submitted,

CHARLES D. HOWARD,
Chemist.

DECEMBER 20, 1913.

The opinions expressed in the above report having been those of a local man, and the agitation referred to continuing, the board of water commissioners decided to employ Professor George C. Whipple, of the firm of Hazen & Whipple, water engineers of international reputation, to make a careful and elaborate investigation of the whole situation. Following is Professor Whipple's report:

REPORT OF THE WATER SUPPLY OF CONCORD BY GEORGE C. WHIPPLE.

July 13, 1914.

Mr. Percy R. Sanders,
Superintendent of the Water Works,
Concord, N. H.:

DEAR SIR—In accordance with the request of the President of the Water Commissioners, I have made a careful sanitary inspection of the water supply of your city, and I hereby present my report.

In preparation for the investigation I have examined the Annual Reports of the Water Department, the reports of the Concord Health Department, and the analyses that have been made from time to time in the laboratory of the State Board of Health. I have also read certain reports on the quality of the water made by Dr. Charles D. Howard, the chemist of the State Board of Health.

In the forenoon of Friday, June 26th, I made an inspection of the catchment area in company with you and Dr. Howard. On this trip samples of water were collected and tested for the presence of algæ, etc. I also visited the high service reservoir and the pumping station. In the afternoon of the same day an inspection of the reservoir was made, using a launch.

As a result of these investigations it is my opinion that the city of Concord has an excellent water supply. It is safe and sanitary and there is no

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reason why it should not be used for drinking and for all domestic purposes. It is unnecessary to boil it, and it is unnecessary for the citizens of Concord to purchase spring water from fear that the water drawn from the taps is not safe.

The Board of Health records of the city show no indication that the water has been the cause of typhoid fever or diseases which may be spread through the agency of a public water supply. The water is attractive in appearance, almost odorless, clear and nearly colorless. It is soft and palatable.

The odor of the water is the only physical quality which seems likely to be occasionally at fault. All New England lakes and reservoirs are affected occasionally with growths of microscopic organisms. Some of these produce unpleasant tastes and odors. There is no question but that such growths of organisms occur in Penacook Lake and they will doubtless occur in the future. Unpleasant as they may be, there is no reason to believe that the odors or the microscopic plants which cause them are deleterious to health. They should not occasion alarm as they do not indicate infection of the water. At the present time the water has no odor due to this cause.

Having made this general statement, I will now discuss some of the conditions in detail and call attention to certain matters which, in my judgment, should be attended to.

The Cleanliness of the Catchment Area.

When surface waters are used without purification, they should be collected from a catchment area that is reasonably clean and free from pollution by fecal matter. The records of the Water Department state that the catchment area of Penacook Lake is about three square miles. The area of the lake is about 338 acres, and to this should be added about 30 acres which represents the area of Forge Pond, now practically a part of the lake. Forge Pond has a catchment area of about 200 acres. The lake has a total length of approximately two miles. The catchment area comprises woodland and farmland. On the west side of the lake a highway extends from the lower end of Forge Pond to the extreme upper end of the lake. Its distance from the lake shore varies from 500 to 2,000 feet except at the two ends of the lake where it approaches closely to the shore. A part of the catchment area of the east side of the lake is also traversed by a highway, but this is at a considerable distance from the lake.

There are on the catchment area somewhat over a dozen dwelling houses occupied permanently throughout the year. All of these were visited by us. The premises were examined and information obtained as to the number of persons and farm animals at each place. As a result of this hastily made census it was found that the permanent population of the catchment area is about 75 persons, or something less than 25 persons per square mile. During the summer this population is increased by an indefinite number of persons who temporarily occupy the cottages along the shore of the lake. It seems probable that during short periods of the sum-

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mer season the population of the catchment area may be considered as about 50 per square mile. There are about 100 cows and between 30 and 40 horses kept at the various farms. At Sunnyside there is a poultry yard where about 700 hens are said to be kept. There seems to be nothing abnormal for a farming region on this catchment area, if we except the cottages which are located near the lake shore.

There are no artificial sewerage disposal systems on the watershed. The sanitary conveniences at the different houses include privies and cesspools. Most of these are satisfactorily located with respect to the lake. The soil of the watershed is generally porous and well adapted to the reception and natural purification of the liquids from the cesspools. The largest cesspools are those at the State Farm, but they are located several hundred feet from the lake in sandy soil and there is not the slightest reason to believe that any of the contents reach the waters of the lake by percolation. There are one or two cases where there is an opportunity for surface water to carry household wastes into the lake at times of rain, but these are matters that can easily be corrected and have all been brought to your attention. The chief danger from cesspools, however, is not while they are in use but at the time when they are being cleaned. In some cases we are informed that it was the practice to dispose of the contents on the surface of the ground, but in a number of instances the practice is to bury the fecal matter in the ground, covering it with earth. This is the proper method and should be insisted upon, whether the privy be located near the lake or at a considerable distance from the lake. The object of this is to avoid accidental contamination of the water.

While it is true that animal manure does not cause typhoid fever, yet this substance should be kept out of public water supplies. Obviously, it is impossible to eliminate all animal manure from catchment areas which include farms and farm lands. Cows, sheep, and other animals require water and it is but natural that they seek it in streams and ponds. In this way all surface waters become more or less contaminated. Even streams which drain nothing but forest lands may become contaminated from the manure of birds, squirrels and other warm-blooded animals. These sources of contamination are relatively unimportant from a hygienic point of view when compared with pollution by human fecal matter. In the case of the water supply of Concord, the water is subjected to long storage before it flows to the city, which causes the danger of even the animal contamination to be reduced to a minimum. The use of manure on plowed fields is a natural use of the land. The washings of fields thus manured is bound to enter the lake at certain times of the year. While this is a source of contamination that cannot be wholly eliminated, it should be reduced when possible. Often this may be accomplished by friendly arrangements with the landowners. Some of the fields of the State Farm are located near the lake and it is said that during the past season this land was heavily manured with the result that the washings entered the lake. This condition might and should be prevented. When manure is applied to land on watersheds ridges at the bottoms of the hills should be constructed to retard the surface flow, and cause more of the water to soak into the ground

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before reaching the lake. This would benefit the farmer as well as the water supply. The poultry farm maintained by the state is another possible source of contamination by animal manure. While these are matters that should be attended to, I do not regard them in the present instance as being serious. The analyses of the Concord water made by the State Board of Health do not indicate any marked contamination from this source.

For the most part, swamps are conspicuously absent on the catchment area and accordingly the color of the water is very low. There is, however, a small swamp at the upper end of the lake which, in my judgment, should be drained. At the present time it forms a breeding place for microcsopic organisms.

The summer cottages along the shore deserve special consideration. Here, if anywhere, the waters of the lake are in danger of contamination by human fecal matter. Many of the cottages have been already purchased by the city. This general policy of the Concord Water Board is one which I approve. The city should control the entire shore line of the lake in order to prevent the sources of contamination from being located too near the water. This does not necessarily mean that it is necessary for the city to actually own all of the land along the shore. Doubtless arrangements can be made by which the owners of land will take adequate precautions against contamination. The wisdom of purchasing any given piece of property must depend largely upon the price for which it can be purchased. The present situation does not warrant the paying of excessive prices for the mere sake of holding title to the shore line.

I have inspected the premises at the St. Paul's School boathouses, and find the sanitary arrangements to be satisfactory. The water used in the shower baths does not enter the lake, but is discharged into the ground. It is my judgment that the use of the lake for boating carried on under proper restrictions is not deleterious to the hygienic quality of the water supply of Concord.

Summer Versus Winter Conditions.

It is a well-known fact that the typhoid fever bacillus does not multiply in water. If the germs of this disease get into the water they do not live many weeks, and very few of them live more than a few days. They are able to survive much longer in cold water than in warm water, and it is a fact that most typhoid fever epidemics which have been traced to water have occurred during the colder months of the year, and that water-borne typhoid fever is more common in northern than in southern latitudes. Surface waters are less likely to transmit intestinal diseases during the summer than during the winter. This tends to minimize the effect of temporary summer pollution on the watershed, the effect of summer cottages, and the effect of accidental contamination from persons who boat or fish on the lake or along the shores. Furthermore, sedimentation, the disinfecting influence of sunlight, and other destructive agencies combine to minimize the effect of contamination during warm weather.

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The Typhoid Fever Record at Concord.

The typhoid fever record of Concord for many years has been exceptionally good. Data received from the local Board of Health and hereto appended have indicated that during the twelve years from 1902 to 1913, the largest number of deaths from this disease in any one year was four, while during two of these years there were no deaths from typhoid fever. The maximum typhoid fever deaths per 100,000 was 18.3, the average, 10.3, and the minimum 0. These records compare very favorably with those of cities supplied with filtered water or with well water. Even more significant than this low typhoid fever death rate is the distribution of the typhoid fever cases during the year. The records show that most of the cases have occurred during the late summer and autumn, and that the number of cases of this disease occurring during the winter has been very small. Since waterborne typhoid fever occurs chiefly in cold weather this distribution would not have occurred if any considerable amount of this disease had been caused by the public water supply. To me, the figures mentioned are significant and indicate unmistakably that the water supply of the city has been safe.

Objections to Surface Water.

It must be admitted that there are certain inherent objections to a water supply taken from the surface of the ground. One of these is the possibility of accidental contamination by the fecal matter of some person who happens to be sick with typhoid fever, or who is one of those unfortunate individuals, who, having had this disease, retain the germs of it in their system for long periods of time. Such persons are termed "typhoid fever carriers." It is said that in round numbers about one person out of every 40 or 50 who have had this disease remain carriers for a considerable period of time. Fortunately the number of typhoid fever carriers in the country at large is decreasing, for the reason that this disease is being gradually stamped out. It is partly because of the danger of this accidental contamination that sanitary engineers favor the filtration of surface waters. It is recognized, however, that storage is an important agency in protecting a water supply against accidental infection, and the long storage provided by Penacook Lake is in itself an important factor in the local problem.

Another objection to the use of surface waters is from the growth of microscopic organisms which takes place in waters stored in reservoirs and lakes. In respect to these growths great differences are noticed between different parts of the country, and sometimes between different lakes and reservoirs quite near together. The effect of these microscopic organisms, most of which belong to the vegetable kingdom, is to make the water slightly turbid and produce unpleasant tastes and odors of water at certain times of the year, chiefly in summer. Penacook Lake is not entirely free from such growths, and the water occasionally acquires a vegetable and woody, or it may be a fishy odor. At the time of my inspection the water contained only a few of these organisms and the odor which they produced was practically negligible. Algæ have been observed in the waters of the

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lake for many years. They were mentioned by Dr. T. M. Drown in the report which he made to the city in the year 1891. Apparently, they have been no more numerous in recent years than they were then. The growth of these organisms depends upon many different conditions which cannot be discussed at length in this brief report. One of the important factors, however, is the food supply which they demand. Manure is used to fertilize the land and contribute to the growth of the crops. When it is allowed to wash into the lake it tends to fertilize the lake and contribute to the growth of microscopic plants. This is one of the reasons why care should be taken to exclude surface wash from Penacook Lake.

Stagnation.

In this latitude all lakes which are as deep as Penacook Lake undergo two periods of what is called "stagnation," one during the summer and one during the winter. At these times the water at the bottom does not mix with the waters above, and it usually becomes foul through the decomposition of organic matter. Following these periods of stagnation the foul water becomes mixed with the waters above and may give rise to noticeable odors. At such times also microscopic organisms are likely to develop and add to the odor. In all probability this condition occurs in Penacook Lake, but thus far it has not been studied.

Nothing can be done to prevent this, and it is mentioned here merely to explain why it is that during the spring and fall there is a slightly noticeable odor to the water.

Cleanliness of the Distribution System.

The water supply of Concord is taken from the lake at a point several hundred feet from the gatehouse. It first passes through a brick conduit laid along the bottom of Forge Pond. It then passes through two sets of screens in the gatehouse and flows to the city through cast-iron pipes. An inspection of the screens showed an accumulation of organisms of various kinds. On the screens were found leaves, small fish, frog spawn, fragments of water plants, fresh water sponge, and more or less miscellaneous debris. It is probable that the conduit at the bottom of the lake is not entirely clean and that growths of fresh water sponge are there present. This pipe moss, as it is sometimes called, is almost always present in conduits through which surface waters are flowing. The algæ, above mentioned, serve as food for these pipe organisms. Practically the only harm they do in the pipes is to occasionally make the water slightly dirty and turbid in some parts of the city where by reason of excessive draughts they become dislodged.

Samples taken by us from certain of the taps of the city showed that in most cases the water was exceptionally free from turbidity. A sample from the tap in the State Laboratory, however, contained a considerable amount of sediment, which was evidently derived from the pipes.

I have suggested to you that the screens of the gatehouses be cleaned daily during the summer season and that the pipes of the city be thoroughly flushed by taking certain streets, one at a time, and increasing the velocity of the water through the pipe so as to thoroughly clean out any accumu-

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lated dirt. A velocity of about 8 feet per second is needed for efficient flushing. To do the work properly will require several weeks. It should be done at night.

High Service Reservoir.

The water in the high service reservoir appeared to be free of algæ growth at the time of our inspection.

Water Analyses.

I have examined with care the analyses of the Concord water which have been made by Dr. Howard in the laboratory of the State Department of Health. The methods used have conformed to standard methods.

The chemical analyses have been more complete than is necessary. It would be useful, however, to have microscopical examinations of the water made regularly by the Sedgwick-Rafter method and by the use of the cotton filter. It would also be useful to maintain records of the number of bacteria in the water and the approximate number of B. coli. At present these tests are made, but infrequently.

Quantity of Water Available.

At the present time there are no records which adequately show the quantity of water that is being used by the city. It is thought, however, that this quantity is not far from 3,000,000 gallons per day. If this figure is correct, it seems probable that the limit of the capacity of the catchment area of Penacook Lake has been nearly reached, and that the most important problem of the near future will be to secure an additional supply of water. The level has been below high-water mark for a number of years. The chief reason for this probably has been the recent lack of rainfall, but doubtless an increased water consumption has been another reason.

In anticipation of the need of additional water, it seems to me that immediate steps should be taken to secure accurate records of the water now being used, and I recommend the installation of Venturi meters on the pipe lines leading to the city. The expense of these meters would not be large and the definite results obtained would be of great value to the city.

Conclusion.

In conclusion, I wish to express my thanks to the Mayor, and the members of the Water Board, the Secretary and Chemist of the State Board of Health, and yourself for affording me the ample opportunities for conducting the present inspection. And I wish to congratulate the citizens of Concord on having at hand such an excellent water supply as that of Penacook Lake.

Attached to this report will be found certain data in regard to the typhoid fever records of the city and some of the cotton discs which were used in the examination of samples of the sediment found in the water in different parts of the system.

Yours respectfully,

[Signed] GEORGE C. WHIPPLE,
Consulting Engineer.

CONCORD, N. H.

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TYPHOID FEVER DEATH RATES, 1902-1913.

Year.	Population.	Typhoid Fever Deaths.	Typhoid Fever Death Rate per 100,000.
1900	19,632	..	....
1901	19,819	..	....
1902	20,006	3	14.9
1903	20,193	3	14.8
1904	20,380	1	4.9
1905	20,566	3	14.6
1906	20,753	3	14.4
1907	20,940	0	0.0
1908	21,127	1	4.7
1909	21,314	4	18.8
1910	21,497	0	0.0
1911	21,684	3	13.8
1912	21,871	4	18.3
1913	22,058	1	4.5
Average, 1902–1913,			10.3

NUMBER OF CASES OF TYPHOID FEVER REPORTED TO THE CONCORD BOARD OF HEALTH DURING THE MONTHS FROM JANUARY, 1902, TO DECEMBER, 1913.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1902	0	0	0	0	1	2	2	0	13	4	0	1	23
1903	0	2	0	1	0	0	1	0	2	6	3	2	17
1904	0	0	0	0	0	1	5	0	2	3	1	0	12
1905	3	1	1	0	1	3	0	1	0	8	4	1	23
1906	3	0	0	1	0	0	5	8	5	5	2	3	32
1907	2	2	2	0	0	0	0	0	2	0	3	0	11
1908	0	0	0	1	0	0	0	2	0	3	0	0	6
1909	2	0	2	0	0	1	2	2	3	11	3	2	28
1910	1	1	0	1	1	0	0	6	1	2	1	2	16
1911	1	0	2	1	0	1	0	0	1	2	2	0	10
1912	0	0	0	0	0	2	1	1	9	2	0	0	15
1913	0	0	0	0	1	0	2	1	2	1	2	1	10
Total	12	6	7	5	4	10	18	21	40	47	21	12	203

NOTES.

1903. "Large number of cases traced to sources outside of city."

1904. "Source of most of these cases was located beyond the limits of the city."

1905. "Several of hospital cases were brought here for treatment from other places."

1906. "Largest number of cases ever reported to this office in one year * * * widely scattered over the city. Several trace their origin outside."

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1909. "Eight of these cases were brought to the hospitals from out of town."

1910. "Origin of several of these cases was traced to sources outside of the city."

THE STATE OF NEW HAMPSHIRE,
STATE BOARD OF HEALTH,
LABORATORY OF HYGIENE, STATE HOUSE.

Mr. Percy R. Sanders,
Superintendent of Water Works,
Concord, N. H.:

DEAR SIR—While appreciating the opportunity kindly afforded by you, any extended comment from me upon Professor Whipple's report hardly seems called for, and might indeed be deemed somewhat out of place.

Were it not that there is really no ground for any intelligent controversy as to the questions of quality and safety involved in this supply, I might be inclined to feel some gratification over the fact that this report fully sustains the views already expressed by me at various times.

As to sanitary conditions upon the watershed, opinions might differ even among experts as to the best course to pursue, or how far the board should go. For the latter it therefore becomes largely a matter of the kind of policy it chooses to follow; and in the determination of such Professor Whipple's report should prove most helpful.

As is pointed out, the problem is not one involving any question of immediate or appreciable danger, but rather of taking such action as will tend to conserve the highest degree of purity and ultimately to eliminate any debatable risk of objectionable contamination. This is an ideal toward which relatively few of our American waterworks systems have striven in the past; yet it is something which is everywhere being demanded today, and Concord citizens will be satisfied with nothing less. As the engineer points out, any body surface water located or inhabited area is liable to fecal contamination at times and for this reason sanitary experts are more and more inclining in favor of the uniform application of some variety of treatment to supplies of this character. Such is in the direction of exercising the same precaution as is instanced by the taking out of fire insurance; the fact that most of us never realize on the latter is not a deciding feature.

In the absence of purification, any policy with a view to reducing the chances of objectionable contamination to the lowest possible limit is thoroughly justifiable and to be commended. It is true that many features offer no especial danger in themselves, particularly under proper restrictions; the difficulty generally is, however, in successfully enforcing such restrictions. Thus there can be no objection to the practice of boating, so long as those concerned behave themselves; and there is no particular objection to the application on the watershed of the manure of cattle to a receptive soil, when conditions are such that this food for both terrestrial and aquatic vegetation will not be washed directly into tributary brooks.

Personally, I feel that Professor Whipple's comment with regard to chemical analysis is a very pertinent one; at the same time it may be well

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to point out that in such matter we are following the standard practice, such as is regularly pursued by Massachusetts and other states in the routine examination of water supplies. While we have never regarded this supply as a troublesome one in point of odors due to organisms yet the algae feature is most interesting and will undoubtedly warrant the special study suggested.

Very truly yours,

CHAS. D. HOWARD,
Chemist State Board of Health.

JULY 21, 1914.

MERRIMACK.

Concerning this source, the chemist of the board has submitted the following report:

Samples recently submitted from the system supplying the village of Merrimack with water having shown the presence of sewage bacteria, the town was visited July 24, 1914, for the purpose of investigating the situation.

This supply is controlled by the United Realty Company, which is an organization subsidiary to the W. H. McElwain Company, the latter corporation conducting a factory for the manufacture of leather and employing the bulk of the labor in the village. During 1910 this company sunk a series of driven wells near the bank of the Souhegan River, with a view to securing a public supply system. The quality, however, was unsatisfactory and these wells had to be abandoned. Shortly afterward a system was installed involving direct pumpage from the river, the intake being at the dam, near the north bank. Subsequent examinations of water from this system have uniformly indicated the existence of sewage pollution.

At the present time there are forty-five services, supplying approximately 300 persons. Total income, at $5 per service, $225 annually. The water, which is pumped continuously during the day, is delivered from two wooden tanks, and in addition to the domestic use mentioned, the supply furnishes steam for the shop. For the manufacture of leather and for fire purposes, there is a separate system, consisting of water pumped from the canal. The fire system mentioned applies only to the shops; there are no hydrants and no residence fire protection other than the pressure available at the sill-cocks for ordinary lawn hose connection.

In addition to the McElwain shops, a table manufactory and a mill for the production of excelsior furnish labor to the residents. The company's representative, Mr. H. L. Clough, who is also superintendent of the water works, informs me that they have taken particular pains to instruct the takers that the water is dangerous and must not be used for drinking without boiling. It is, however, admitted that notwithstanding this warning, there is considerable carelessness in this respect, especially on the part of the foreign element.

Although it is claimed that there is no serious source of contamination of the Souhegan River for a distance of some six or seven miles above

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Merrimack, yet it is common knowledge that this small stream undergoes extensive pollution at a number of points during its course, receiving as it does all of the sewage of the town of Wilton, as well as most of that of Greenville and Milford, and also undoubtedly a certain amount from Amherst and some other places. Unquestionably, use of the raw water as taken at Merrimack is attended by very grave danger, being liable as it is to give rise to an epidemic of typhoid or other serious enteric disorder at any time. The fact that such may not as yet have occurred is of course no argument whatever in favor of the inocuousness of the supply. The discharge of typhoid dejecta in connection with the sewage delivery above is by no means necessarily of continuous or even frequent occurrence; and when the latter does occur, it may be that the stream conditions at that particular time are favorable for the practical elimination of the bacilli before reaching Merrimack; and the viability of the few remaining such bacilli may be so low that the average **healthy** adult is able, with his good resistance powers, to swallow these without experiencing any ill effects. Yet in the case of children or infants, or of adults whose vitality has become reduced, a different sequel may result.

On the other hand, the necessary conditions are liable to come about at any time, giving rise to a violent epidemic. A further reason why the use of a contaminated public water supply should be condemned, and particular effort directed toward its improvement, is in the fact that such a supply is liable to "seed" the village with a few cases of "typhoid carriers"—persons very seriously liable to infect any food stuff which they may handle or come in contact with.

Allowing a minimum of 50 gallons per capita per day (it would doubtless exceed this quantity during the summer in view of extensive use on arid garden soils) and adding one third for boiler consumption at the shops, it would appear that the total daily consumption must be in the neighborhood of 20,000 gallons. The installation of a mechanical filter plant to handle this quantity would be a relatively inexpensive matter. Such a filter could easily be set up either in or near the small building at the dam. The plant should include (a) a small settling basin to permit of sedimentation for a few hours—particularly at times of rains, when the water would be abnormally turbid, (b) provision for the application of a coagulant (alum), (c) a gravity (open) filter tank (the closed or pressure variety is not to be recommended), and (d) means for the application of a dose of chlorine (or, if preferred, calcium hypochlorite) to the filtered water. A properly constructed plant of this character, properly operated, would afford a supply entirely safe (practically sterile) and the equal of spring water. After being established it would not require regular skilled attention, and in fact would require but a small amount of daily attention on the part of the shop engineer or other person assigned to the duty.

Were this a clear lake water—such as is dealt with at Laconia—it is quite probable that the chlorine sterilization alone would be sufficient. While the application of such a treatment to the river water would undoubtedly render it "safe" most of the time, yet such an arrangement in the case of a stream supply is at best to be regarded as but a temporary

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makeshift. The proper procedure necessary to produce a satisfactory supply involves a combination of the above with filtration.

As an alternative to purification, I am informed by Mr. Clough that the company may at an early date investigate the feasibility of securing a supply of pure ground water from driven wells, to be sunken on an elevation west of the village. Unfortunately, the driven well proposition is a somewhat uncertain one as to results, in point of both quality and quantity; yet many villages are now thus supplied, and such a system would undoubtedly have advantages over one based upon the application of purification to the river water.

Still another alternative to which it is intimated the company may resort involves the abandonment altogether of this utility, it being represented that any adequate improvement would represent an outlay for which there would be no corresponding compensation. It may be pointed out that such abandonment could only be effected following application to the public service commission. In view of the value of such a service to the community, it is believed, however, that some plan can be evolved to care for the financial feature involved—either through an increase in rates or public-spirited assistance on the part of individuals. In any case, however, particular emphasis should be given to the fact that continuance of the system in question in its present form cannot be indefinitely tolerated. Action of some sort should be taken immediately.

Respectfully submitted,

CHARLES D. HOWARD,
Chemist.

JULY 29, 1914.

The above report having shown that the present character of the Merrimack water supply is dangerous, the water company was directed to effect satisfactory improvement. As a result of this Mr. Robert Spurr Weston, consulting engineer, has submitted a report in which he recommends a system involving use of water from the abandoned driven wells constructed in 1910, such to be subjected to deferrization and filtration. As his tests have shown that these wells will afford sufficient water which can be satisfactorily purified in this way this plan is given preference over the alternative one of filtration of Souhegan River water, the net cost of which latter he estimates as being somewhat greater. Such plan has accordingly been adopted by the company, following its approval by the board, and the latter has received assurance that construction will be commenced upon the new system at the earliest feasible moment. The estimated cost of these improvements is slightly under $12,000.

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HENNIKER.

The following reports by the chemist bear upon the supply of the Henniker Spring Water Company, and proposed extensions thereto:

On June 16, 1913, an examination was made of the water system of the Henniker Spring Water Company. This consists (a) of two large square wells on a hillside in woodland about three fourths of a mile southwest of the village, and (b) two wells similarly situated at about the same distance northwest of the village on the other side of the river. Although cattle get into these woods, there is in neither place any chance for contamination. The wells are roofed over and one of these roofs is in a high state of decay; wells also have not been cleaned since constructed—several years ago. This might be done with advantage, although, with two or three noticeable exceptions, past analyses have indicated an excellent water.

At this date the Bay State Well Drilling Company are drilling an eight-inch well close by the present upper well on the southwest location. Had reached a depth of about 40 feet, mainly through a light, soft clay. They expect to go down as much as 200 feet and are planning to syphon from this into the well below.

The water as drawn from taps in the village is of excellent appearance, fine flavor and has a high reputation. This supply is not available for street or lawn sprinkling.

The well above referred to was continued to a depth of 359 feet (219 feet through solid granite ledge.) The result was a failure, a flow of only two gallons per minute being encountered.

During February, 1914, a second well 400 feet deep (370 feet through solid rock) was completed. The yield from this also was disappointing, being not over eleven gallons per mnute as indicated by a two-days pumping test.

Meanwhile, certain citizens having become interested in the matter of the installation of a public water supply system, an examination was made November 4th of Crany Hill Pond, a source under consideration. As the appended report, dated November 11, 1913, indicates, this source was found to be scarcely suitable:

This pond, lying in a depression between two hills situated about four miles south of Henniker Village, is an oblong sheet of water of from 20 to 30 acres area. The altitude of Crany Hill is given on the map as 1,200 feet above sea level, and as that of the pond is apparently between 200 and 300 feet lower, it is evident that as a source of water supply an exceptionally high pressure would be afforded. While no definite figures are as yet at hand, it has been estimated that the difference in elevation between the pond and the village is not less than 500 feet. Under such circumstances, provided the source was acceptable, it should be possible—as has been

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suggested—to advantageously utilize some of this pressure for the generation of electric current, if the volume of water should prove sufficient therefor.

From the northern end of the pond a small brook flows down to the Contoocook. The pond has no inlet, being entirely spring fed. The total area of the two water sheds (eastern and western) is roughly estimated as in the neighborhood of 200 acres. The eastern watershed is wooded. On the western one are situate three small farms, with buildings, and including some cultivated land, with pasturage at present utilized by about twenty head of stock. There is no probability of any contamination from farm drainage. Although the land for fifty rods, more or less, back from the western shore is wooded, it is apparent that horses and cattle at present roam through these woods and wade into the pond. This, however, is a matter that could be easily adjusted.

At the present time there are two fishing camps located on the shores. While it is claimed that these camps are used but very little, and it is evident that the summer cottage has not as yet become an institution at this pond, yet it seems to be the case that the latter is a favorite resort for fishing parties. According to some "records" found displayed at one of these camps, it would appear that the varieties of fish most abundant are horn-pout and pickerel.

As is well known, the habitat most favored by such fish is a grassy stream or pond with muddy bottom, and such is exactly what I found to be true of Crany Hill Pond. The shores at both the upper and lower extremities are boggy in character and are covered for a considerable area by a heavy growth of swamp grass. In fact, the whole western shore is semi-swampy in character, being doubtless underlayed by springs, of which two or three good sized ones were observed seeping out of the ground a few rods from the shore.

The pond at this side is said to be quite deep. On the eastern side, however, the slope is gradual, soundings from a boat at a distance of about 100 feet from shore and taken in the neighborhood of the protruding rocks indicating a depth at this point of but two to three feet only, with a muddy bottom. While this eastern shore is higher and cleaner than the other side, yet there is but one short stretch—some fifty feet—of clean, gravelly beach, the balance being grass-grown. It is probable, however, that a sand or gravel stratum underlies the surface at no great distance below, and that the small beach referred to represents a spot which has become denuded of its humus covering.

This dirt cover is one result of the rather abundant growth of vegetation noted. Another is manifested in the character of the water. It is inevitable that water stored in such a reservoir must—regardless of its original purity—show a considerable degree of color and dissolved vegetable matter, and carry a comparatively large amount of microscopic life, together with the attendant odors and taste—the latter liable to become more or less marked at times and especially following heavy rains.

Although water showing these characteristics in varying degrees is not uncommonly in use for domestic purposes, and is not necessarily unhealthful, yet as a general proposition a source carrying beyond a certain amount

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of color and organic matter is hardly to be regarded as potable, and its installation for public supply purposes is not to be recommended. Whether or not the character in a given case is such as to warrant non-acceptance depends somewhat upon the local restrictions as regards other available sources, also upon the standard of quality of the water supplies in the district in question. What might be considered poor in one section of the country might very likely be regarded as acceptable in some other. In New Hampshire, where we have as a rule clear and clean supplies of a low degree of color, the standard in this respect is relatively somewhat high; and where at all practicable, such standard should be maintained in any given case.

The following analyses represent samples collected as follows: No. 11730, from brook, just below emergence from pond; No. 11731, from 100 feet off eastern shore, near rocks, in three feet of water; No. 11732, from gravelly shore on eastern side. As reference has been made to the new Pembroke Pleasant Pond supply, the analysis afforded by a sample of this water is also included for purposes of comparison.

ANALYSES OF SAMPLES COLLECTED FROM CRANEY HILL POND, NOVEMBER, 1913.
(Parts in 100,000)

	11730	11731	11732	Pleasant Pond
Odor	decided hay-like, with distinct fishy or rock-weed odor, more pronounced on heating.			
Taste	Faintly fishy; more pronounced on heating.			None noted.
Color	0.40	0.35	0.40	0.05
Turbidity	v.sl	v.sl	v.sl	faint
Sediment	Sl. veg	sl. veg	sl. veg	v.sl
Total solids	3.1	3.5	3.0	3.2
Fixed solids	1.3	1.4	1.0	1.5
Free ammonia	0.0006	0.0008	0.0006	0.0010
Albuminoid do	0.0214	0.0180	0.0255	0.0110
Nitrates	0.008	0.002	0.002	0.005
Nitrites	none	none	none	none
Chlorine	0.11	0.11	0.12	0.30
Hardness (soap)	0.6	0.6	0.5	0.7
Alkalinity	0.6	0.6	0.5	....
Acidity to phenolphthalein after boiling	0.3	0.3	0.3	....
Colon bacilli (1cc & 10cc)	neg.	neg.	neg.	neg.
Microscopical	Many dictyospharium, also numerous pandorina			nothing notable

The above analyses indicate a very pure, soft water, so far as any drainage contamination is concerned; yet, as a whole, the results are unfavorable.

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The degree of color, while higher than that of many of our New Hampshire surface supplies—much higher than some of them—is nevertheless probably not great enough to warrant, of itself alone, condemnation of this source, although any noticeable degree of color in the glass is aesthetically objectionable. In this case the color is somewhat greater than that of the Manchester supply, and, as will be noted, is very much greater than that of Pembroke's new source. On the other hand, it is not as high as that of the towns of Berlin, Goffstown, Somersworth, and the present source of the Suncook Water Company.

In other respects, however, this water departs largely from the character of Pleasant Pond, and in fact tends to approach that of the present Suncook supply, from which that town is now seeking relief. Further, at this time at least, the taste and odor are more marked than is generally true of the latter, notwithstanding that the source of the Suncook supply is much more swampy than this, and in an aesthetic sense very much more objectionable.

The proportion of nitrogenous organic matter, as indicated by the albuminoid ammonia content, is comparatively high, higher in fact than the average exhibited by any other surface supply in New Hampshire. The nearest approach to it in this respect is the emergency supply of Wilton, consisting of a pond of similar character. On the other hand, it is apparent from the very low free ammonia content that this nitrogenous matter occurs in quite a stable form and that it is not liable to undergo putrefactive changes readily. In short, aside from the fact that it is present in considerably larger amount than conforms to our standards, there is probably nothing injurious about this organic matter.

At the present time the water carries a microscopical population of objectionable character. In addition to the types more or less abundant in the average surface water, two varieties of chlorophyceae (dictyospharium and pandorina) were noted in considerable numbers. These tend to swim near the surface, being noticeable to the naked eye as a cloud of minute moving points, whenever the surface of the water in the sample bottle was disturbed. Here, too, the objection is based upon aesthetic grounds, in that such organisms impart a fishy or oily taste and odor to the water, such being more apparent when the latter is heated. In the case of these samples, the taste, though faint, is noticeable, while the odor of the water confined in the gallon receptacle is quite distinct.

Conditions of similar character are not infrequently met with in other surface supplies, it being entirely possible that the Pleasant Pond source cited may show something of this nature at times. Ordinarily, however, this is a fugitive condition and it is seldom that it persists indefinitely, although it has been known to give a great deal of trouble in the case of certain supplies elsewhere. Here the conditions are favorable for the propagation of such growths. Yet it would be well to make later observations regarding this feature. As has been suggested, it is possible that as a result of the recent rains, following a very dry summer, all of the abnormal conditions referred to may be in exaggerated form at the present date. However, there is not much hope, in the case of a reservoir of this character, of

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any very marked degree of improvement being noted at any time. Color and dissolved vegetable matter are inherent properties of this water.

In conclusion, I regret therefore that it seems necessary to report adversely as to this source, although, as already intimated, I do not feel that a final decision would be quite warranted at this time and believe that later observations would be worth while. It may be stated, however, that the citizens of Henniker would find the change from the present source of drinking water to that under discussion a radical one.

It is very probable that clearing and stripping the shores would result in some improvement, although it would appear that the extensive degree of such necessary for radical improvement would involve a rather large expenditure. This, however, is something that cannot be definitely determined without a detailed engineering survey upon which actual estimates might be based.

Incidentally, a somewhat novel remedy occurs to me in connection with the suggested plan to utilize the excess water pressure. Provided the volume of flow should prove sufficient for the purpose, this proposition would not only prove probably cheaper than any extensive cleaning up at the pond (beyond, I mean, the commonly practiced clearing up of the shores), but it would consist in the installation at some elevated point on the pipe system of a turbine for the generation of current. From the turbine the water would be accumulated in a small artificial reservoir, from which it could be fed to a battery of two rapid filters, such, for example, as are now in use with the Lebanon supply. The effluent, thus deprived of its excess of color, vegetable matter and organisms, would compare very favorably with the present spring water supply—in fact, could be made practically as good. Filters of this variety are not expensive to install and in conjunction with a power plant could be operated very advantageously. Of course, the feasibility of the power feature could only be determined following actual measurements of the available flow from the pond; the filtration would be dependent upon this only to the extent that, requiring daily supervision, its conduct alone would involve some expense.

Later, the town entered into an agreement with the present water company and engaged the services of Mr. W. S. Johnson, consulting engineer, to see what could be done toward development of the present sources of the spring water supply as well as the securing of an addition thereto. As the following report of June 25, 1914, indicates, it was found that the spring supply could be materially increased in volume, and this, together with an auxiliary supply consisting of a large dug well, will, it is believed, solve the problem of a water supply for this village.

Some months ago the town entered into an agreement through its water supply committee with the present Henniker Spring Water Company, the arrangement being to take over the stock and property of such

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company. A clause of the agreement provides that only ground water shall be supplied, thus barring out the utilization of a surface source, such, e. g., as a pond. As a matter of fact, there seems to be no satisfactory pond water economically available.

After what seems to have been a very careful and thorough investigation of the situation by Mr. William S. Johnson, engineer, the latter has recommended as a town water supply the development of the present springs system, supplemented when found necessary by water from a large well to be constructed upon a certain area. This plan is set forth in detail in the reports of the engineer and of the committee, copy of which is submitted herewith. Briefly, the plan consists (a) in materially increasing the volume of water available from the present springs system through the collection of water from one of the springs now going to waste. It is estimated that such loss is approximately equivalent to the present total supply. By suitable means all of this spring water is to be collected in a cemented reservoir of 250,000 gallons capacity, located upon a hill just below one of the spring basins and at an elevation of about 185 feet above Proctor Square. It is believed that with the improvements that will be effected the present system can thus be made to afford a quantity of water ample for all except the summer season—and by this is meant an abundance not only for general household use but for lawn and garden sprinkling, as well as for adequate fire protection.

It is planned to supplement this supply during the dry season (b) by a large dug well located in what is known as the Garland pasture at a point about a half mile southeast of the village. My examination of this tract on the date of writing shows what would seem to be an unusually favorable situation for the collection of a very large volume of pure ground or spring water. The tract in question lies between two small spring-fed brooks, the proposed location for the well being a few rods below the base of a steep bluff, the ground at this point being very springy and apparently saturated with water.

Water from this well would be pumped into the mains and thence into the reservoir by power from an oil engine. It is represented that such engines are extremely economical to operate, it being claimed that pumpage against a 200-foot head for a period of three hours each day during one hundred days would cost but approximately $125, inclusive of fuel, labor and all other expense.

The committee have agreed to purchase sufficient land and to fence such in a manner as to properly exclude cattle from the immediate neighborhood of the well. The latter will be about 20 feet deep, the upper courses of its side-walls laid in cement, and the whole provided with a tight cover of concrete. A sample of water recently submitted to the laboratory from a test well sunken on this site gives very promising indications as to quality, although it should be stated that at the time this sample was collected conditions incident to the construction were not sufficiently settled to allow of the collection of water entirely free from earthy matter, and accordingly it is not possible at this time to report absolutely regarding all features involved in a consideration of the quality. It is the opinion,

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however, based upon both the analysis and an examination of the site in question, that the water here obtained will prove of perfectly satisfactory quality.

The plans for the proposed reservoir involve construction of cement and concrete, with a concrete cover, the latter to be overlaid by about two feet of soil, thus properly preserving the quality of a supply of this character.

Because of perfect clarity and the absence at all times of color, odor and taste, a ground water supply, such as the plan here outlined contemplates, is greatly to be preferred to a surface water source, whenever such can be secured in adequate quantity. For their success in finding a means whereby the citizens can continue to enjoy water of the character referred to this water supply committee is to be congratulated.

At this date we are informed that construction is completed, and the system is a success in every way.

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FOOD AND DRUG EXAMINATIONS.

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REPORT ON FOOD AND DRUG EXAMINATIONS.

CHARLES D. HOWARD, *Chemist.*

Dr. Irving A. Watson,
Secretary, State Board of Health:

DEAR SIR—I beg to submit herewith a summary of the work of food, drug and liquor examinations for the biennial period ending August 31, 1914; also certain comments and recommendations bearing thereon. The details of this work will be found in the bulletins issued during the period included.

The greatly increased burdens placed upon the laboratory as a result of the operation of the Law of 1913 relative to the inspection of water supplies, also in connection with the control of the operation of installations for water disinfection, has seriously handicapped the work of food and drug examination during the past two years.

The following tabular summary indicates a total of 985 articles examined, inclusive of 886 foods and liquors and 99 drugs and medicinal preparations.

TABLE SHOWING NUMBER AND VARIETIES OF FOODS EXAMINED.

	Total Samples.	Not Conformable.
Bread	5	0
Breakfast foods	4	0
Butter	13	5
Coffee and substitutes	22	6
Cider	5	2
Candy	4	1
Canned fruits and vegetables	9	2
Cocoa and chocolate	5	0
Cream	48	4
Flavoring extracts	54	27
Honey	4	0
Ice cream	111	31
Jellies and jams	6	4
Liquors	154	44
Maple products	9	1
Milk	294	*156
Milk products	9	0
Non-alcoholic beverages	56	20

*Inclusive of 71 Standard as to composition but showing slightly too much sediment to be passable as clean milk.

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	Total Samples.	Not Conformable.
Olive oil	6	1
Salad preparations	5	4
Spices	17	5
Soda water ingredients	13	5
Vinegar	10	4
Miscellaneous foods	38	8
Totals	901	330

DRUG EXAMINATIONS.

	Total Samples.	Not Conformable.
Alcohol	2	0
Borax	1	1
Chlorinated lime	5	1
Camphorated oil	2	0
Formaldehyde	9	0
Fowler's Solution	6	1
Fluid extract ginger	1	1
Glycerin	1	1
Hydrogen peroxide	5	4
Lime water	1	1
Milk sugar	1	0
Quinine tablets	5	1
Sodium salicylate tablets	8	1
Spirits nitrous ether	5	3
Spirits camphor	3	1
Spirits anise	2	0
Miscellaneous official drugs	21	3
Proprietary remedies	21	9
Totals	99	28

MILK INSPECTION.

Because of the interest manifested in the special grade known as Inspected Milk, the number of samples submitted of the ordinary market variety has not been so great as in the past. While the proportion of the inspected grade produced is still relatively small, the fact of the existence of such has served to stimulate local inspectors to give special attention to the production of a cleaner milk, with the result that the efforts of the latter have been directed more largely than in the past to bettering conditions at the dairy itself. With one conspicuous exception, the number of samples submitted to this department from cities and towns unprovided with laboratory equipment for

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milk examination has been comparatively small. It needs to be realized that while the dairy inspection is highly essential, the laboratory examination, as constituting the final proof of results achieved, should not be neglected.

As has been previously pointed out,* the establishment of a special grade of milk is of value to the people of the state at large only in so far as such may serve as a stimulus to the improvement of the milk supply of the average consumer. The latter will necessarily continue to be the object toward which the bulk of our efforts should be directed.

The following table, with summary, shows the results in detail of examination of milk as submitted from the various towns. These results are not inclusive of those for Inspected Milk. While it may appear from the table showing summary of results of food examinations in general that the proportion of non-conformable milk samples was unduly large, it should be noted that the figure given is inclusive of a considerable number of samples which were objectionable only in that, although not exactly "dirty," they showed too large a proportion of sediment to be passable as "clean."

*Bulletin, April, 1914, p. 55.

No.	Town.	Solids %	Fat %	Remarks.
6356	Amherst*	9.90	2.4	Watered. Produced by C. L. Smith.
6357	Amherst*	9.87	2.4	Watered. Produced by C. L. Smith.
6358	Amherst*	11.23	3.2	Watered. Produced by C. L. Smith.
6650	Amherst	14.62	5.6	Bacteria 4200. Clean.
6614	Antrim*	10.58	2.0	Skimmed. Collected of W. C. Hills.
7023	Antrim*	11.50	2.5	Skimmed. Collected of W. C. Hills.
6684	Berlin	....	3.2	Sample very sour when received.
6330	Barnstead*	12.47	3.2	Slightly dirty.
6331	Barnstead*	12.17	3.2	Clean.
6332	Barnstead	14.39	3.8	Slightly dirty.
6333	Barnstead*	13.37	4.0	Slightly dirty.
6369	Canaan	12.09	3.8	Clean.
7145	Canaan	15.30	5.8	Dirty.
6644	Claremont	13.43	3.8	Bacteria 4800. Clean.
6276	Claremont	12.80	4.0	Clean.
6346	Claremont	13.32	4.2	Bacteria over 500,000. Dirty.
6348	Concord	12.15	3.8	Bacteria 17,000. Clean.
6648	Concord	12.37	4.0	Bacteria 1300. Clean.
6651	Concord	13.60	4.5	Bacteria 5800. Clean.
6652	Concord	13.21	4.1	Bacteria 10,200. Clean.
6653	Concord	13.80	4.7	Bacteria 15,900. Clean.
6437	Concord	....	...	No preservatives.
7027	Concord*	11.24	3.1	Below standard.
7037	Concord*	11.48	3.7	Below standard. No added water.
7038	Concord*	11.28	3.2	Below standard. No added water.
7030	Concord*	11.39	3.0	Below standard.
7031	Concord*	11.56	3.4	Below standard.
7035	Conway	12.70	4.0	Clean.
7036	Conway	11.40	3.0	Below standard. Slightly dirty.
6353	Deering*	11.93	3.4	Below standard. Dirty.
6354	Deering*	11.86	3.8	Below standard. Dirty.
6355	Deering*	10.48	3.6	Watered. Dirty.
6643	Derry*	13.64	4.6	Bacteria 5900. Clean.
6345	Derry*	13.99	3.8	Bacteria 15,000. No sediment but stains filter-pad.
6641	Dover	13.41	3.8	Bacteria 400. Clean.
7146	Dover	12.40	3.4	Clean.
7078	Franklin	13.21	4.0	Slightly dirty (Clark).

*Same producer or dealer.

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No.	Town.	Solids %	Fat %	Remarks.
7079	Franklin	15.09	5.6	Clean (Webster).
7080	Franklin	12.23	3.5	Slightly dirty (Kimball).
7081	Franklin	13.24	3.8	Clean (Mickey).
7082	Franklin	12.16	3.2	Slightly dirty (Kelley).
7083	Franklin	15.39	5.8	Slightly dirty (Osgood).
7084	Franklin	15.31	5.6	Clean (Webster).
7085	Franklin	13.64	4.6	Clean (Thompson).
7086	Franklin	14.83	5.2	Clean (Rayon).
7095	Franklin	13.28	4.3	Clean (Stevens).
7096	Franklin	12.77	4.1	Slightly dirty (Kelley).
7097	Franklin	14.65	5.4	Clean (Gruby).
6283	Durham	12.08	3.8	Very sour when received.
6605	Durham	13.79	4.0	Very dirty.
6606	Durham	13.01	3.8	Slightly dirty.
6607	Durham	12.88	3.6	Slightly dirty.
6608	Durham	13.29	4.1	Slightly dirty.
6609	Durham	16.10	5.8	Slightly dirty.
6450	Franconia	12.36	3.6	Slightly dirty. Numerous spores.
6451	Franconia	13.32	4.2	Slightly dirty. Increased leucocytes.
6452	Franconia	12.67	3.6	Slightly dirty.
6453	Franconia	12.42	3.4	Slightly dirty.
6314	Gorham	14.10	4.6	Slightly dirty.
6352	Goshen	15.55	5.8	Some very fine sediment.
6656	Goffstown	12.95	3.7	Bacteria 33,000. Clean.
6657	Hanover	14.98	5.5	Bacteria 1100. Clean.
6662	Hampton Falls	15.16	5.7	Bacteria 7700. Clean.
6269	Hopkinton*	12.32	3.6	No added water.
6270	Hopkinton*	13.69	4.0	No added water.
7063	Hopkinton	12.49	3.7	
7064	Hopkinton	12.45	3.8	
6654	Hopkinton	12.42	3.5	Bacteria 28,700. Clean.
6659	Hopkinton	15.68	5.6	Bacteria 14,200. Clean.
6379	Henniker	12.81	3.6	Clean.
	Hudson	12.24	4.3	Slightly dirty.
6641	Keene	13.37	4.0	Bacteria 59,400. Clean.
6520	Keene	13.44	4.0	Clean.
6378	Keene	14.35	4.4	Clean.
7029	Keene	12.67	4.5	Clean.
6398	Laconia	12.84	3.8	Clean.
	Laconia	13.13	4.4	Clean. Bacteria 20,500.
6264	Littleton	15.00	5.5	Clean.
6272	Manchester†	9.98	2.8	Watered (submitted by dealer).
6273	Manchester	9.68	2.4	Watered (submitted by dealer).
6274	Manchester	10.19	2.8	Watered (submitted by dealer).
6275	Manchester	10.06	2.8	Watered (submitted by dealer).
6288	Manchester (Bedford)	11.13	3.2	Watered (G. W. Boynton).
6289	Manchester (Bedford)	10.14	3.0	Watered (G. W. Boynton).
6290	Manchester (Bedford)	10.83	3.2	Watered (G. W. Boynton).
6291	Manchester (Bedford)	10.63	3.0	Watered (G. W. Boynton).
6463	Manchester (Auburn)	11.14	3.7	Watered (Henry Rivers).
6464	Manchester (Auburn)	11.27	3.7	Watered (Henry Rivers).
6465	Manchester (Auburn)	11.36	3.7	Watered (Henry Rivers).
6466	Manchester (Auburn)	11.36	3.6	Watered (Henry Rivers).
6523	Manchester (Bedford)	10.75	3.0	Watered (J. A. Labrecque).
6524	Manchester (Bedford)	10.43	3.0	Watered (J. A. Labrecque).
6525	Manchester (Bedford)	9.51	2.8	Watered (J. A. Labrecque).
6526	Manchester (Bedford)	9.54	2.8	Watered (J. A. Labrecque).
6527	Manchester (Bedford)	8.99	2.8	Watered (J. A. Labrecque).
6528	Manchester (Bedford)	6.57	2.0	Watered (J. A. Labrecque).
6529	Manchester (Bedford)	8.51	1.6	Watered (Carroll McQuesten).
6530	Manchester (Bedford)	6.63	2.0	Watered (Carroll McQuesten).
6532	Manchester (Auburn)	11.61	3.8	Watered (collected of dealer).
6533	Manchester (Auburn)	11.40	3.8	Watered (collected of dealer).
6572	Manchester	9.44	2.6	Watered (collected of dealer).
6573	Manchester	10.25	2.8	Watered (collected of dealer).
6574	Manchester	10.62	3.0	Watered (collected of dealer).
6575	Manchester	10.69	3.0	Watered (collected of dealer).
6587	Manchester (Auburn)	11.38	3.6	Watered (Henry Rivers).
6588	Manchester (Auburn)	11.29	3.8	Watered (Henry Rivers).
6589	Manchester (Auburn)	10.61	3.2	Watered (Henry Rivers).
6598	Manchester	10.45	3.5	Watered (S. Kozatek).
6599	Manchester	9.96	3.3	Watered (S. Kozatek).
6655	Manchester	13.40	4.6	Bacteria 5100. Clean.
7154	Manchester (Loudon)	8.49	2.8	Watered.°

*Same producer or dealer.

†The Manchester samples for the most part represent special cases of adulteration in which the local inspector acted as an agent of the State Board of Health.

°Investigation showed employee of non-resident owner responsible. Employee discharged.

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No.	Town.	Solids %	Fat %	Remarks.
7155	Manchester (Loudon)	8.53	2.9	Watered.°
6658	Merrimack	13.20	4.2	Bacteria 3700. Clean.
6347	Newport	14.10	4.6	Bacteria 9000. Clean.
6637	Northumberland	12.07	3.0	Slightly dirty. Odor.
6242	Nashua	12.34	3.6	Clean.
6292	Nashua‡	13.30	4.4	Slightly dirty. Hudson producer.
6293	Nashua‡	13.06	4.0	Slightly dirty. Hudson producer.
6294	Nashua‡	12.09	3.8	Dirty. Hudson producer.
6295	Nashua‡	13.30	4.4	Slightly dirty. Windham producer.
6296	Nashua‡	12.10	3.2	Slightly dirty. Hollis producer.
6297	Nashua‡	9.13	2.8	Watered. Very dirty.
6298	Nashua‡	....	14.0	Top milk. Slightly dirty. Merrimack producer.
6299	Nashua‡	12.88	4.2	Dirty.
6300	Nashua‡	11.32	3.8	Very dirty. Below standard.
6301	Nashua‡	11.42	3.4	Slightly dirty. Below standard.
6302	Nashua‡	11.82	3.8	Slightly dirty. Below standard.
6303	Nashua‡	11.10	3.2	Dirty. Below standard.
6304	Nashua‡	11.67	3.4	Slightly dirty. Below standard. Hollis producer.
6305	Nashua‡	11.96	3.4	Dirty. Below standard.
6306	Nashua‡	11.93	3.6	Slightly dirty.
6340	Nashua	15.02	5.4	Clean.
6362	Nashua	12.93	3.8	Clean. A few streptococci.
6365	Nashua	....	3.2	Slightly dirty.
6604	Nashua	14.12	5.4	Clean. Bacteria 7640.
6422	Pembroke	....	...	No preservatives.
6646	Peterboro	14.16	5.1	Bacteria 4500. Clean.
6645	Peterboro	14.13	4.4	Bacteria 3800. Clean.
6660	Peterboro	14.64	4.7	Bacteria 165,000.
	Peterboro	12.20	3.6	Clean.
	Peterboro	12.72	4.0	Slightly dirty.
	Peterboro	13.31	4.3	Slightly dirty.
	Peterboro	11.92	3.5	Clean. Below standard.
	Peterboro	15.20	5.8	Dirty.
	Peterboro	13.15	4.5	Very dirty.
6626	Peterboro*	11.05	1.5	Skimmed. Normal microscopically.
6636	Peterboro*	14.55	5.0	Clean. Bacteria 1500. Normal microscopically.
6629	Peterboro*	12.61	3.8	Clean. Bacteria 3800. Normal microscopically.
6631	Peterboro*			
6649	Portsmouth	....	5.0	Clean. Normal microscopically.
7026	Portsmouth	14.34	6.0	Clean. Bacteria 1200.
	Portsmouth	9.32	0.8	Skimmed. Many hay bacilli.
	Portsmouth	12.70	4.2	Clean. Bacteria 3600.
	Portsmouth	12.08	4.0	Clean. Bacteria 7200.
	Portsmouth	12.06	3.8	Clean. Bacteria 4600.
5470	Rochester	14.60	5.8	Bacteria 350,000.
5517	Rochester	15.88	...	Disagreeable odor.
6317	Somersworth	13.28	4.0	Slightly dirty.
6315	Somersworth	10.50	3.2	Watered. Dirty.
6316	Somersworth	13.56	4.2	Slightly dirty (Boucher§).
6318	Somersworth	13.31	4.2	Slightly dirty (Wentworth).
6319	Somersworth	14.03	4.8	Clean (Coffin).
6320	Somersworth	12.36	4.0	Slightly dirty (Lauzon).
6321	Somersworth	12.08	3.6	Clean (Billings).
6322	Somersworth	11.84	3.4	Clean. Below standard (Hodgdon).
6323	Somersworth	14.55	4.6	Clean (Paradis).
6324	Somersworth	13.33	3.8	Clean (Clement).
6325	Somersworth	12.82	3.8	Clean (Johnson).
6326	Somersworth	13.05	4.2	Clean (Files).
6327	Somersworth	11.10	3.0	Slightly dirty. Below standard (Turgeon).
6328	Somersworth	12.82	3.8	Slightly dirty (Vachon).
6329	Somersworth	11.35	3.2	Clean. Below standard (Lapointe).
6330	Somersworth	12.57	3.8	Slightly dirty (Drolet).
6468	Somersworth	12.68	4.0	Clean (Ricker).
6469	Somersworth	12.73	4.0	Slightly dirty (Lauzon).
6470	Somersworth	13.26	4.4	Slightly dirty (Boucher).
6471	Somersworth	11.94	3.6	Clean. Below standard (Turgeon).
6472	Somersworth	13.76	4.2	Clean (Hopkins).

°Investigation showed employee of non-resident owner responsible. Employee discharged.

‡Submitted by consumers representing Nashaway Woman's Club.

*Same producer or dealer.

§This and the names following mainly represent the dealers of whom samples were taken. The supply of some of these dealers is from a number of different producers.

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No.	Town.	Solids %	Fat %	Remarks.
6473	Somersworth	13.19	4.2	Clean (Drolet).
6474	Somersworth	13.77	4.2	Clean (Vachon).
6475	Somersworth	13.48	4.4	Clean (Hodgdon).
		11.51	3.0	Slightly dirty. Below standard (Vigeau).
6476	Somersworth			
6477	Somersworth	14.22	4.6	Clean (Paradis).
6478	Somersworth	12.77	4.0	Clean (Lapointe).
6479	Somersworth	12.72	4.0	Dirty (Ricker).
6480	Somersworth	15.04	5.6	Clean (Johnson).
6481	Somersworth	12.64	4.2	Clean (Boucher).
6482	Somersworth	14.73	4.6	Clean (Files).
6483	Somersworth	13.40	4.4	Clean (Coffin).
6535	Somersworth	12.72	3.6	Slightly dirty (Clement).
6536	Somersworth	13.83	4.8	Dirty (Vegeux).
6537	Somersworth	13.84	5.0	Clean (Hodgdon).
6538	Somersworth	13.04	3.0	Clean. Low fat (Paradis).
6539	Somersworth	13.83	4.7	Slightly dirty (Johnston).
6540	Somersworth	12.06	3.0	Slightly dirty (Coffin).
6541	Somersworth	13.21	3.4	Very dirty (Ricker).
6542	Somersworth	13.59	4.0	Dirty (Drolet).
6543	Somersworth	12.69	3.2	Clean (Files).
6544	Somersworth	12.76	3.4	Slightly dirty (Vachon).
6545	Somersworth	13.18	3.8	Dirty (Boucher).
6546	Somersworth	13.79	4.0	Dirty (Hannigan).
6547	Somersworth	12.27	3.0	Dirty (Turgeon).
6548	Somersworth	12.37	3.4	Clean (Clement).
6549	Somersworth	13.97	4.2	Slightly dirty (Lauzon).
6550	Somersworth	14.22	5.2	Clean (Wentworth).
6551	Somersworth	12.47	3.4	Clean (Billings).
6552	Somersworth	14.58	4.8	Slightly dirty (Haggetty).
6615	Somersworth	12.74	3.2	Slightly dirty (Lapointe).
6616	Somersworth	13.68	4.6	Slightly dirty (Boucher).
		12.05	4.0	Slightly dirty. No added water (Lanzon).
6617	Somersworth			
6618	Somersworth	13.63	4.4	Slightly dirty (Wentworth).
6619	Somersworth	13.29	4.2	Slightly dirty (Vachon).
6620	Somersworth	12.64	3.8	Slightly dirty (Lapointe).
6621	Somersworth	13.61	4.4	Clean (Paradis).
6622	Somersworth	12.03	3.2	Clean (Ricker).
6623	Somersworth	13.66	4.6	Clean (Drolet).
6624	Somersworth	12.65	3.9	Clean (Hodgdon).
6625	Somersworth	12.80	4.2	Clean (Canute Farm).
6626	Somersworth	11.81	3.4	Very dirty. Below standard (Vegeux).
6627	Somersworth	13.10	4.4	Dirty (Turgeon).
6628	Somersworth	12.82	3.8	Slightly dirty (Johnson).
6629	Somersworth	14.90	5.0	Slightly dirty (Coffin).
6630	Somersworth	12.97	4.0	Clean (Clement).
7051	Somersworth	14.85	5.0	Clean (Files).
7052	Somersworth	13.36	3.8	Clean (Vachon).
7053	Somersworth	13.21	4.0	Clean (Charet).
7054	Somersworth	12.35	3.6	Clean (Johnston).
7055	Somersworth	13.63	4.6	Dirty (Paradis).
7056	Somersworth	12.09	3.6	Slightly dirty (Tibbetts).
7045	Somersworth	11.89	3.2	Clean. Below standard (Turgeon).
7046	Somersworth	13.29	4.2	Filthy (Coffin).
7047	Somersworth	12.46	3.2	Clean (Emery).
7048	Somersworth	12.63	3.6	Slightly dirty (Clement).
7049	Somersworth	13.43	4.0	Slightly dirty (Files).
7050	Somersworth	13.81	4.2	Slightly dirty (Drolet).
7057	Somersworth	13.43	4.0	Slightly dirty (Canute Farm).
7058	Somersworth	13.47	4.0	Slightly dirty (Vegeux).
7059	Somersworth	12.70	3.4	Clean (Hodgdon).
7060	Somersworth	13.35	4.2	Dirty (Lapointe).
7061	Somersworth	12.54	3.0	Dirty (Gregorokes).
7153	Somersworth	12.43	3.0	Slightly dirty (Emery).
		13.28	4.4	Clean (St. Peter). Microscopically normal.
7103	Somersworth	14.23	4.6	Clean (Charet).
7104	Somersworth	14.86	5.0	Clean (Dronin).
7105	Somersworth	11.37	3.0	Slightly dirty. Below standard (Bemis).
7106	Somersworth	13.33	4.4	Clean (Tramble).
7107	Somersworth	11.76	3.0	Clean. Below standard (Hannigan).
7108	Somersworth	12.31	3.8	Dirty (Haggetty).
7109	Somersworth	13.24	4.2	Dirty (Lobisonier).
7110	Somersworth	13.64	4.4	Dirty (Burstaris).
7111	Somersworth	14.73	4.8	Slightly dirty (Rouloud).

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No.	Town.	Solids %	Fat %	Remarks.
7112	Somersworth	12.71	4.0	Dirty (Desmaris).
7113	Somersworth	12.33	4.0	Dirty (Vegeaux).
7114	Somersworth	13.27	4.4	Clean (Morrison).
7115	Somersworth	12.87	4.1	Dirty (Lapointe).
7116	Somersworth	11.90	3.6	Clean. Below standard (Turgeon).
7117	Somersworth	11.57	3.4	Slightly dirty. Below standard (Lauzon).
7118	Somersworth	12.62	4.0	Dirty (Gregorokes).
7119	Somersworth	12.39	3.8	Clean (Drolet).
7120	Somersworth	11.33	3.2	Slightly dirty. Below standard. (Thibeault).
7121	Somersworth	12.60	4.0	Slightly dirty (Canute Farm).
7122	Somersworth	14.61	5.4	Clean (Hodgdon).
7123	Somersworth	13.26	4.4	Clean (Emery).
7124	Somersworth	11.98	3.7	Clean. Below standard (Clement).
7125	Somersworth	12.56	3.8	Clean (Files).
7126	Somersworth	12.18	3.6	Slightly dirty (Tibbetts).
7127	Somersworth	13.58	4.4	Clean (Vachon).
7128	Somersworth	13.19	4.0	Clean (Paradis).
7129	Somersworth	12.48	3.7	Clean (Johnston).
7130	Somersworth	13.13	4.2	Slightly dirty (Coffin).
7131	Somersworth	13.60	4.4	Very dirty (Horne).
6691	Seabrook	13.69	4.5	Slightly dirty (Tucker).
6692	Seabrook	12.53	4.1	Dirty (Chase).
6693	Seabrook	12.26	4.0	Slightly dirty (Gore).
6694	Seabrook	13.66	4.4	Dirty (Knowles).
6695	Seabrook	13.91	4.8	Slightly dirty (Blatchford).
6696	Seabrook	13.91	5.0	Dirty (Evans).
7067	Seabrook	13.26	4.2	Slightly dirty (Perkins).
7068	Seabrook	12.45	4.0	Slightly dirty (Perkins).
7069	Seabrook	13.34	4.2	Slightly dirty (Perkins).
7070	Seabrook	12.72	4.1	Clean (Perkins).
7071	Seabrook	13.28	4.2	Clean (Perkins).
7072	Seabrook	12.68	3.4	Slightly dirty (Perkins).
7073	Seabrook	14.67	5.2	Slightly dirty (Perkins).
7074	Seabrook	11.16	3.0	Slightly dirty. Below standard (Perkins).
7075	Seabrook	12.00	3.6	Slightly dirty (Perkins).
7076	Seabrook	12.78	3.8	Slightly dirty (Perkins).
6384	Stewartstown	13.57	3.8	Very dirty (collected of Mohawk Dairy Co.)
6385	Stewartstown	12.65	3.4	Very dirty. Sold as "guaranteed pure pasteurized milk."
6386	Stewartstown	12.86	3.6	Clean (Harvey).
7156	Sunapee	11.46	2.1	Very dirty. Skimmed ("as supplied at hotel").
6373	Walpole	14.56	4.2	Some blood and increased leucocytes.
6467	Wakefield (Union)...	14.05	5.0	Clean. Increased leucocytes.
6681	Wilton	12.78	3.8	Dirty. Barn-like odor.
6383	Whitefield	13.35	4.2	Clean.

Total samples examined.....	294.
Acceptable (clean and legal composition).....	112, equivalent to 38%
Slightly below standard but clean.....	13, equivalent to 4%
Slightly dirty	80, equivalent to 27%
Dirty	31, equivalent to 10%
Very dirty	11, equivalent to 3%
Below standard as drawn.....	28, equivalent to 9%
Skimmed	5, equivalent to 2%
Watered	38 (11 producers) 3%

Prosecutions.

Seven complaints have been filed by the chemist for the sale of milk containing added water. Five of these—all in Hillsborough County—resulted in fines of from twenty-five to fifty dollars, inclusive

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of one jail sentence of sixty days, suspended. The two remaining complaints were both against a Rockingham County producer, representing second and third offenses, respectively. In no one of the three instances involved has this office been able to secure definite information as to any action that may have been taken. It has been, however, learned that the party in question has gone out of the business of milk production.

Two complaints for the sale of sub-standard ice cream, and five in connection with beverages which were improperly labeled or adulterated with saccharin, all resulted in convictions and the imposition of fines. It is not believed that any artificial sweetener is being knowingly used at the present time by any New Hampshire bottler. The cases in question were all in connection with sales by transients.

Inspection of Liquors.

Special discussion of this subject appeared in the Bulletin for July-October, 1914, page 66. Under the law of 1903, the Laboratory of Hygiene is required to examine and report to the commission concerning the grade of liquor on sale as indicated by samples submitted by its agents. In determining such quality, the Commission holds that it must be guided by the definitions as laid down in the special law referred to rather than by the less obsolete and more practical provisions of the food and drug law. If anything of value is to be accomplished under the present system of regulating the quality of liquors, it is indispensable that this feature of the law be revised. It is apparent that in its present form and as applied to present conditions it is not enforceable.

Of the 156 samples examined, forty-four were found to be either improperly labeled or not in accord with accepted standards. A large proportion of the samples were drawn from bulk, being sold as "whiskey," without any distinguishing qualification. Under the present definition of the latter beverage, it would be impossible—contrary to what has been urged—to exclude from sale the compounded varieties and confine the term to the aged-in-the-wood type altogether. The former are not necessarily "impure," as is so frequently alleged. It is all a matter of type—i. e. of proper labeling—of getting what one pays for. Consequently, the main point to be determined, aside from alcoholic content, is whether or not the

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vendor is properly representing the character of the goods he sells. The accepted standard calls for an alcoholic content of not less than 40 per cent (80 proof). In quite a number of instances where the strength has fallen below this, the inspectors have noted that the labeling of the cask denoted a reduced proof. Unless, therefore, the dealer specifically notifies the purchaser concerning such reduced strength—an improbable circumstance—the fraud perpetrated upon the latter differs in no degree from what it would be were the vendor to add the water himself. This form of adulteration is very common and there should be some means of checking it. It may be pointed out that a large share of the profit attaching to the manufacture and sale of distilled liquors is based upon the more or less liberal use of water—a state of affairs which only the rigid enforcement of a standard of alcoholic strength will serve to cure.

Abolition of Use of Serial Number.

Following the action of the federal department, it was recommended that the provision for the use of a serial number and its publication upon the label in connection with New Hampshire guaranties be discontinued. There can be no question that the previous use of the guaranty statement has proved extensively misleading.

Net Weight Law.

An amendment of the food and drug law, adopted by the legislature of 1913 and identical in language with a federal amendment, provides that on and after November 21, 1914, all food in package form shall bear a statement upon the label as to the net weight, measure, or numerical count of the contents.

In this connection reference may be made to a bill which was defeated at the last session but which will doubtless come up again in 1915, such bill providing not only for state supervision of sales by weight or measure of all commodities but also for the periodical supervision and checking up of all weighing and measuring appliances. Laws of this character are now very generally in force in other states, and there can be no serious question as to the needs in this respect in New Hampshire.

It may be pointed out that in the administration of such laws due recognition should be given to the fact that in so far as they

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apply to foods and drugs a close relation exists between such and the operation of the food and drug law. Reference has already been made to the fact that under the food law an article is misbranded if it bears no statement, or an incorrect statement, concerning its weight or measure. Not only is the determination of the actual weight or measure logically the first step in connection with the general examination of food, but also in connection with the matter of a proper weight allowance, or tolerance, a certain amount of chemical investigation is not infrequently essential. Any system which provided for a duplication of such sampling or examinations would obviously represent an extravagance as well as an unnecessary encroachment upon this department.

For this reason a not uncommon arrangement in other states involves placing the enforcement of both laws under one administrative head. However, a measure of the character under discussion necessarily deals with so many other commodities than foods and drugs, and involves so many considerations foreign to the work of a health department, that the wisdom of such a course is at least open to question. Certainly such an arrangement should not be effected unless adequate provision was made for a deputy who should give his whole time to the matter.

Sale of Cold-Stored Foods.

At present there is but one commercial cold storage plant within the state. Consequently the adoption of the more or less elaborate regulations for the conduct of the cold storage business, as now in force in quite a number of other states, is uncalled for here. At the same time a very large quantity of cold stored articles of food are annually shipped to and sold in this state, and there can be no question that some special regulation governing the sale of such articles would be helpful in protecting the consumer from fraud or injury. The principal application of such a law—a bill for which was defeated at the last session—would be in connection with the sale of eggs and poultry. It is notorious that not a little fraud is practiced in the sale of both articles. Unquestionably the sale of poultry in a state of partial decomposition is annually responsible for numerous cases of enteric disorders. It is true that, under the general food law, a decomposed article of food is to be deemed as adulterated. Nevertheless a special statute covering this point, particularly one which would specifically

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provide for action in connection with the seizure and final disposition of unwholesome provisions, should be helpful.

To cite an example, founded upon actual occurrences: Even though it may appear reasonably certain that a given lot of provisions is responsible for the sudden development of diarrhœal attacks among the patrons of a restaurant or hotel, the average inspector with due regard for property rights will hesitate some time before proceeding to confiscate or to prohibit the use of the provisions in question. Very frequently the results of a casual examination may be indeterminate, and to withhold from use pending a laboratory examination might involve no inconsiderable loss or embarrassment to the owner. Yet there is good reason for believing that every year there is sold to New Hampshire consumers thousands of pounds of provisions which should instead have been either buried or burned, or sent to a rendering or fertilizer plant.

Clean Advertising.

After clean food and honest medicines, one of the greatest needs attaching to the production and sale of these commodities is their clean and honest advertising. The state of affairs regarding adulteration and misbranding of foods and drugs as existent twenty years ago was no worse—if as bad—than it is today, relative to the practice of openly and deliberately publishing false representations concerning the value of commodities.

This conspiracy on the part of the manufacturer and the publisher to deceive the consumer has its best known exemplification in connection with the sale of patent medicines and so-called "medicinal" foods; yet the practice of course extends in some degree to every form of commodity. It is in fact merely one of those "trade practices" left over from the time when all sorts of fraud and misrepresentation in connection with the manufacture and sale of food and medicines were held up as justifiable on the ground of business expediency.

The better class of publishers, however, realizing that something needs to be done, particularly to secure release from the thralldom of a certain type of advertisers, are themselves taking steps with a view to procuring an abatement of the evil. Under Canadian law, thanks largely to their efforts, false advertising is now a misdemeanor. The Canadian statute provides that:

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"Every person who knowingly publishes, or causes to be published, any advertisement for either directly or indirectly promoting the sale or disposal of any real or personal movable or immovable property or interest therein, containing any false statement which is of a character likely to or is intended to enhance the price or value of such property or any interest therein, or to promote the sale or disposal thereof, shall be liable upon summary conviction to a fine not exceeding two hundred dollars, or to six months' imprisonment, or to both fine and imprisonment."

Each year also sees the number of state false advertising laws increased. Bills to this effect have already been introduced in New Hampshire, but thus far they have failed of passage.

Department Needs.

Reference has been made elsewhere to the handicap which other forms of inspection must experience as a result of the increasing demands in connection with the control of water supplies. A great deal more work could be done, and should be done, along the lines of food and drug inspection. To keep pace with what even the average amongst the progressive states are accomplishing in this respect would demand materially increased facilities. In order to accomplish more than a mere superficial discontinuous attack upon the problem, the employment is demanded of at least one inspector who should devote his whole time to the routine side of food and drug inspection, together with an additional assistant chemist to handle the increased volume of material thus accruing. Under a former arrangement a sum up to one thousand dollars derived from liquor license fees was available for this purpose, in recognition of the requirement regarding the examination of liquors for the state license commission. This sum, however, is no longer available.

Under the present situation the chemist finds himself obliged to devote an unduly large proportion of his time to office work, correspondence, and matters of clerical detail. It would appear that the laboratory, inclusive of both divisions, is a department of sufficient size and importance to warrant the regular employment of a clerical assistant. To render the best service it would be essential that such person be regularly attached to the laboratory in order to acquire the necessary familiarity with the technical character of the work involved. Obviously, for the scientific worker to be obliged to give any considerable share of his time and effort to such matters is not good economy; nor can he, on personal grounds, well afford to spend his time in this manner.

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ORDERS AND SPECIAL REPORTS.

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REGULATIONS PROMULGATED BY THE STATE BOARD OF HEALTH FOR THE PROTECTION OF CERTAIN WATER SUPPLIES.

JACKSON.

Under the date given, the following petition was presented to the State Board of Health by the Board of Health of the town of Jackson:

JACKSON, N. H., November 25, 1912.

To the State Board of Health,
Concord, N. H.:

GENTLEMEN—Your petitioners, the Board of Health of the town of Jackson, N. H., have reason to believe that Rocky Branch Brook, so-called, which is the source of water supply for a part of the town of Jackson, is in danger of pollution, and that the local regulations are not sufficient to prevent such threatened contamination; therefore, we hereby petition the State Board of Health to investigate the situation and to establish such regulations as you may deem necessary to protect the said water supply against any pollution that in your judgment would endanger the public health.

Respectfully submitted,

[Signed] A. C. HARRIMAN,
F. H. WILSON,
Board of Health, Jackson, N. H.

An inspector from the State Board of Health visited the locality and found that some logging camps had been built near the stream from which the water supply of Jackson was taken, and that only a mile and a half, or two miles, from the point where the water enters the service pipe. The situation was found to be such as to endanger the purity of the water of that stream.

The state inspector, in conjunction with the Board of Health of the town of Jackson, made certain recommendations for the discharge of the drainage from the camps to a point which, in their judgment, would not endanger the water supply, which advice the proprietor agreed to carry out to the letter, under the supervision of the local board of health.

The State Board of Health, however, deemed it best to establish regulations under the provisions of the public statutes, which was done at a regular meeting of the board held on December 7, 1912, as follows:

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REGULATIONS OF THE STATE BOARD OF HEALTH FOR THE PROTECTION OF THE PURITY OF THE WATER OF ROCKY BRANCH BROOK IN THE TOWN OF JACKSON.

1. No privy, and no pigpen, stable, or other building or structure in which horses, cattle, swine or fowls are kept, or a cesspool, shall be built or maintained within one hundred feet of the usual channel of Rocky Branch Brook above the intake of the water supply of Jackson, or of any of its tributaries, except in such cases as the local board of health may permit, upon approval of the State Board of Health.

2. No sewage of any kind, sink-water, or water that has been used in washing or cleansing either materials, person or food, shall be allowed to run into said stream, its tributaries, or into any excavation or cesspool in the ground, or on to the surface of the ground, within one hundred feet of the usual channel of said stream or tributaries, except by consent of, and under such conditions and regulations as may be made by the local Board of Health, with the approval of the State Board of Health.

3. No privy, cesspool or place of deposit upon the surface of the ground for sewage, sink-water, or water used for cleansing person or material shall be allowed to exist where it may be reached by high water in the event that the said stream or its tributaries overflow their usual channels, or where rain or melting snow would be likely to wash said material into said stream or its tributaries.

4. No dead animal, or parts thereof, or any article perishable or decayable, and no manure, waste or garbage shall be deposited so near said stream or its tributaries as to endanger the purity of the water.

5. No sawdust, shavings, or other waste from mills or manufactories shall be deposited in said stream or its tributaries, or upon their banks so near the same as to be reached by high water, or to be washed into said streams in any way.

6. None of these things, materials or conditions mentioned in the foregoing regulations, or anything else that might endanger the purity of the said water supply, shall be permitted to exist, whatever may be their distance from the said stream or its tributaries, in such locality or manner as, in the opinion of the board of health, would be liable to contaminate the water of the said stream or its tributaries.

7. No person shall bathe or wash clothing, or in any way or manner defile or contaminate the water of said Rocky Branch Brook above the intake above mentioned.

8. It shall be the duty of the board of health to enforce these regulations.

9. The Public Statutes provide for a fine for violations of regulations established by the State Board of Health for the protection of public water supplies.

BOSCAWEN.

The Board of Health and the Board of Water Commissioners of the town of Boscawen, in view of the fact that there are some cottages, and others being erected, in close proximity to Walker's Pond,

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from which the water supply of Boscawen is taken, petitioned the State Board of Health to establish regulations for the better protection of that source of supply. Following is the petition:

BOSCAWEN, N. H., May 18, 1914.

To the State Board of Health,
Concord, N. H.:

GENTLEMEN—We, the subscribers, who constitute the Board of Health of the town of Boscawen, and we, the subscribers, who constitute the Board of Water Commissioners of the Boscawen Water Precinct, represent that the water of Walker's Pond, so called, located in the towns of Boscawen and Webster, which is a source of public water supply, is contaminated or in danger of contamination, and that the local regulations are not sufficient to protect the said pond from pollution.

We, therefore, do hereby petition, under the provisions of Chapter 57, Laws of 1899, the State Board of Health to establish such rules and regulations as may be necessary to protect this supply against any pollution that might, in the judgment of the board, be dangerous to public health.

Respectfully submitted,

[Signed] A. ALEXANDER,
E. E. GRAVES,
WILLIS G. BUXTON,
Board of Health of Boscawen, N. H.
ELI E. GRAVES,
ALMON G. NORRIS,
F. L. GERRISH,
Board of Water Commissioners of Boscawen, N. H.

A topographical examination of the water-shed of Walker's Pond showed that certain regulations were necessary and that the above mentioned boards were justified in asking the State Board of Health to establish regulations under the provisions of the Public Statutes, which was done at a regular meeting of the board held on July 9, 1912, as follows:

REGULATIONS OF THE STATE BOARD OF HEALTH FOR THE PROTECTION OF THE PURITY OF THE WATER OF WALKER POND, IN THE TOWNS OF BOSCAWEN AND WEBSTER.

1. No privy, pig-pen, stable, or other building or structure in which horses, cattle, swine, or other animals or fowls are kept, shall be built, continued, or maintained within seventy-five feet of Walker Pond (meaning high water mark), or within seventy-five feet of any bay, cove, or inlet thereto, or within seventy-five feet of any stream tributary to said pond, bays, coves or inlets, except in such cases as the local Board of Health may permit, upon the approval of the State Board of Health, and under such regulations as they may require.

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2. No sink-water, urine, or water that has bene used for washing or cleansing either materials, person or food, shall be allowed to run into said pond, or into any bay, cove, or inlet thereof, or into any stream tributary thereto, or into any excavation or cesspool in the ground or on the surface of any ground within seventy-five feet of said pond (meaning high water mark), or of any bay, cove, or inlet, or within seventy-five feet of any stream tributary thereto, except by consent, and under such regulations and conditions as may be given by the local Board of Health, upon approval of the State Board of Health.

3. No dead animal, or fish, or parts thereof, or food, or any article perishable or decayable, and no dung, either human or animal, kitchen waste, swill, or garbage shall be thrown into or deposited in said pond, or left or permitted to remain within seventy-five feet thereof (meaning high water mark), or into any bay, cove, or inlet of said pond, or into any stream tributary thereto, or within seventy-five feet of such bay, cove, or inlet, stream or tributary.

4. No sawdust shall be thrown or be allowed to fall into said pond, or into any stream tributary thereto.

5. No person shall bathe in said pond.

6. No matter, waste, or materials such as are described in sections 2, 3, and 4 shall be thrown, deposited, or allowed to remain upon the ice of the waters of said pond, or upon that of any bay, cove, or inlet thereof, or of any stream tributary thereto.

7. It is the duty of the local Board of Health to enforce the above regulations, and any person violating any regulation established by the State Board of Health shall be punished by a fine of twenty dollars ($20.00) for each offence. Any deviations from the above rules must be by written consent of the State Board of Health.

DOVER.

The following petition was received from the board of health of the city of Dover:

DOVER, N. H., July 30, 1913.

State Board of Health,
Concord, N. H.:

GENTLEMEN—We, the undersigned, members of the Board of Health of the City of Dover, N. H., believing our water supply (known as Willands Pond) is in danger of contamination, hereby petition your honorable body to establish rules and regulations for the protection of said supply.

Respectfully submitted,

[Signed] ANDREW KILLOREN,
E. L. CHAPMAN, M. D.,
H. K. REYNOLDS,
Board of Health, Dover, N. H.

Willand's Pond is one of the sources of water supply for the city of Dover, and is located partly in the city of Somersworth and partly in Dover.

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There were certain conditions surrounding this pond that should not be allowed in connection with a public water supply. An investigation revealed the fact that better protection was absolutely necessary to safeguard the public health interests of the community. The following regulations were therefore established by the State Board of Health at a regular meeting held on October 19, 1913:

REGULATIONS OF THE STATE BOARD OF HEALTH FOR THE PROTECTION OF THE PURITY OF THE WATER OF WILLAND POND IN THE CITIES OF DOVER AND SOMERSWORTH.

1. No person shall bathe or swim in Willand Pond.

2. No person shall expectorate upon the ground within the limits of Central Park, so called. The management of said park shall provide suitable receptacles for the deposit of refuse, such receptacles to be of such character and to be cared for in a manner approved by the local board of health.

3. No food, refuse, garbage, urine, manure, dead animal or fish or parts thereof, wash-water, or waste of any description, shall be thrown into or deposited in said pond or inlet, or be deposited or permitted to remain upon the surface of the ground within two hundred feet thereof.

4. No privy or cesspool, and no pigpen, stable or other building or structure in which horses, cattle, swine or other animals or fowls are kept, shall be built or maintained within two hundred feet of said pond or inlet, except in such cases as the local board of health may permit, upon approval of the State Board of Health.

5. No domestic animals or fowls shall be permitted to enter the water of said pond or inlet, or to frequent the shores within a distance of one hundred feet therefrom.

6. It is the duty of the local board of health to enforce the above regulations, and any person violating any regulation established by the State Board of Health is liable to a fine of twenty dollars ($20.00) for each offence.

7. All of the foregoing regulations will take effect and be in force on and after October 1, 1913. Any deviations from the above rules must be by recommendation of the local Board of Health, and with the written consent of the State Board of Health.

DUBLIN.

Monadnock Lake, in the town of Dublin, is not only the source of water supply for a few individual estates, but it is also one of the great attractions of that somewhat famous summer resort towns.

The board of health of Dublin, desiring to maintain the shores of the lake and its waters in their normal purity, petitioned the State Board of Health as follows:

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DUBLIN, N. H., July 30, 1914.

To the State Board of Health,
Concord, N. H.:

GENTLEMEN—We, the subscribers, who constitute the Board of Health of the town of Dublin, respectfully represent that the water in Monadnock Lake, so called, in the town of Dublin, is, in our opinion, in danger of contamination, and in our opinion the local regulations are not sufficient to protect the said lake from pollution.

We therefore hereby petition your board, under the provisions of chapter 75, Laws of 1899, to establish such rules and regulations as may in the judgment of your board be necessary to protect the waters of the said lake from pollution that might be dangerous to public health.

Respectfully submitted,

[Signed] CLIFFORD GOWING,
WILLARD H. PIERCE,
CLESSON E. GOWING,
Board of Health of Dublin, N. H.

A state inspector, in company with the local board of health, visited the shores of the lake, but found no source of contamination that presented any immediate danger. Nevertheless it was thought best to comply with the petition of the local board of health. The following regulations were promulgated at a regular meeting of the board held on July 9, 1914:

REGULATIONS OF THE STATE BOARD OF HEALTH FOR THE PROTECTION OF THE PURITY OF THE WATER OF MONADNOCK LAKE IN THE TOWN OF DUBLIN.

ARTICLE 1. No privy, pigpen, stable or other building or structure in which horses, cattle, swine or other animals or fowls are kept shall be built, continued, or maintained within seventy-five feet of Monadnock Lake (meaning high water mark), or within seventy-five feet of any bay, cove, or inlet thereto, or within seventy-five feet of any stream tributary to said lake, bays, coves or inlets, except in such cases as the local Board of Health may permit, upon the approval of the State Board of Health, and under such regulations as they may require.

ART. 2. No sink-water, urine or water that has been used for washing or cleansing either materials, person, or food, shall be allowed to run into said lake, or into any bay, cove or inlet thereof, or into any stream tributary thereto, or into any excavation or cesspool in the ground or on the surface of any ground within seventy-five feet of said lake (meaning high water mark), or of any bay, cove, or inlet, or within seventy-five feet of any stream tributary thereto, except by consent, and under such regulations and conditions as may be given by the local Board of Health, upon approval of the State Board of Health.

ART. 3. No dead animal, or fish, or parts thereof, or food, or any article perishable or decayable, and no dung, either human or animal, kitchen waste, swill, or garbage shall be thrown into or deposited in said lake, or left or per-

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mitted to remain within seventy-five feet thereof (meaning high water mark), or into any bay, cove, or inlet of said lake, or into any stream tributary thereto, or within seventy-five feet of such bay, cove, or inlet, stream or tributary.

ART. 4. None of the structures or conditions described in Articles 1, 2, or 3 shall be permitted, even though beyond the minimum limit of seventy-five feet, if thereby the purity of the water is endangered.

ART. 5. No cesspool, privy, stable or place of deposit of sewage of any kind, or for disposing of sink-water, shall hereafter be erected, constructed, built, selected or allowed within two hundred (200) feet of high water mark of said lake or its tributaries without first obtaining the approval of the local Board of Health.

ART. 6. No sawdust shall be thrown or be allowed to fall into said lake, or into any stream tributary thereto.

ART. 7. No person shall bathe in said lake.

ART. 8. No matter, waste, or materials such as are described in sections 2, 3, and 4 shall be thrown, deposited, or allowed to remain upon ice of the waters of said lake, or upon that of any bay, cove, or inlet thereof, or of any stream tributary thereto.

ART. 9. Any deviations from the above rules must be by written consent of the State Board of Health.

DERRY.

Beaver Lake, in the town of Derry, has become a summer resort for a few citizens, who desire to maintain the purity of that body of water; hence they petitioned the State Board of Health as follows:

To the State Board of Health:

We, the undersigned citizens of the town of Derry, State of New Hampshire, having reason to believe that the water in Beaver Lake in said Derry, the same being public water, is being contaminated, and that the local regulations are not sufficient or effective to prevent such pollution, respectfully petition the State Board of Health for the state of New Hampshire to investigate the case, and to establish such regulations as the said board may deem necessary for the protection of the said water supply against any pollution that in its judgment would endanger the public health.

Dated at Derry, this eighth day of June, 1914.

[Signed] JAMES P. COMEAU,
JAMES C. WILLIS,
GEORGE C. CLARKE,
DELIA LICHTENSTEIN,
IRA A. REYNOLDS,
ERNEST L. REYNOLDS,
E. L. DAVIS,
GEORGE W. BENSON,
MRS. F. W. TINKER,
ED. OSBORNE.

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An examination of the locality showed that some protective action was called for inasmuch as the water was being used for domestic purposes and there existed certain sources of pollution that might greatly endanger the purity of the water. The following regulations were therefore promulgated by the board:

REGULATIONS OF THE STATE BOARD OF HEALTH FOR THE PROTECTION OF THE PURITY OF THE WATER OF BEAVER LAKE, IN THE TOWN OF DERRY.

1. No sewage of any kind, sink-water, or water that has been used in washing or cleansing either materials, person or food, shall be allowed to run into Beaver Lake, in the town of Derry, or into any stream tributary thereto. All excavations made for cesspools for sewage shall be so located or constructed that their contents will not in any manner pollute the said lake or its tributaries.

2. No privy, pigpen, cesspool or place of deposit upon the surface of the ground for sewage, sink-water, or water used for cleansing person or material shall be allowed to exist where it may be reached by high water in the event that the said lake or its tributaries overflow their usual channels, or where rain or melting snow would be likely to wash said material into said lake or its tributaries.

3. No dead animal, or parts thereof, or any article perishable or decayable, and no sewage, waste or garbage shall be deposited so near said lake or its tributaries as to endanger the purity of the water.

4. None of these things, materials or conditions mentioned in the foregoing regulations, or anything else that might endanger the purity of the said water or ice supply, shall be permitted to exist in such locality or manner as, in the opinion of the Board of Health, would be liable to contaminate the water or ice of the said lake or its tributaries.

5. It shall be the duty of the Board of Health to enforce these regulations, which shall take effect and be in force on and after August 1, 1914.

INFANTILE PARALYSIS AND CEREBROSPINAL MENINGITIS.

In October, 1913, the State Board of Health added infantile paralysis and cerebrospinal meningitis to the diseases required to be reported to local boards of health and by the latter to the state board. The following order was mailed to all the physicians and local boards of health in the state:

THE STATE OF NEW HAMPSHIRE.
STATE BOARD OF HEALTH.

INFANTILE PARALYSIS (POLIOMYELITIS) AND CEREBROSPINAL MENINGITIS.
Notification Required.

The State Board of Health declares each of the diseases of Infantile Paralysis (Poliomyelitis) and Cerebrospinal Meningitis, in the language of chap-

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ter 16, section 2, of the Laws of 1901, to be a "malignant communicable disease," and also in the language of chapter 110, section 3, of the Public Statutes, to be a "malignant, pestilential disease." Therefore, it is required under the law that both of these diseases shall be reported by the attending physician or the householder to the local board of health, that the premises may be placarded and proper restrictions against the spread of the disease enforced.

IRVING A. WATSON,
Secretary.

A copy of the following suggestions relating to the sanitary management of infantile paralysis was also sent to all physicians and local boards of health.

THE STATE OF NEW HAMPSHIRE.
STATE BOARD OF HEALTH.

INFANTILE PARALYSIS (POLIOMYELITIS).

SUGGESTIONS FOR SANITARY MANAGEMENT OF THE DISEASE.

1. The local board of health, upon receiving notice of a case of infantile paralysis should immediately placard* the house, and should maintain a limited quarantine during the acute stage of the disease.

2. The patient should be isolated as completely as possible in a proper room, which should be clean, well lighted and ventilated, and free from all unnecessary furnishings. It should be screened to keep out insects, as it has been shown that the disease may be communicated, in animal experimentation, by the stable fly. Only those persons who are required to care for the patient should be admitted to the sick-room.

3. The nurses and persons in attendance should be instructed to thoroughly disinfect all discharges, including sputum and nasal secretions, and special care should be taken that all cups, spoons and other articles that come in contact with the patient are sterilized with boiling water or other proper disinfectants.

4. The quarantine should be a limited one. It is not necessary to restrict adults from pursuing their usual occupations in cases where they are not brought in contact with children—like teachers, for instance; but no child from a family in which there is a case of the disease should be allowed to attend any school for at least four weeks after the onset of a case.

5. Such other sanitary precautions should be taken as the local board of health deem essential in the individual case. It is not considered necessary to close schools; but when a case develops in a schoolroom, the room should be disinfected immediately.

6. On the death or recovery of the patient from the acute stage of the disease, the apartment occupied by him should be disinfected. Public funerals should not be allowed.

Infantile Paralysis (*Poliomyelitis*) is not a contagious disease like measles or scarlet fever, for instance. This is evidenced in the fact that only rarely do two cases occur in the same family. The appearance of a case should not create any public alarm.

*Placards are furnished by the State Board of Health.

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That this disease is of an infectious character has been well demonstrated, but the manner of its transmission is obscure. It is considered necessary, therefore, by the highest sanitary authorities to take all reasonable precautions for its restriction, even though it cannot be demonstrated that all of such measures are absolutely necessary.

Information regarding the management of cases of cerebrospinal meningitis, the same being an abridgment of information published by the U. S. Public Health Service, was printed in the Quarterly Bulletin of the State Board of Health and distributed to all physicians and local boards of health in the state. The latter were informed of th eaction of the state board in a communication as follows:

THE STATE OF NEW HAMPSHIRE.
STATE BOARD OF HEALTH.
SECRETARY'S OFFICE, STATE HOUSE,
CONCORD, N. H., November 4, 1913.

To the Board of Health:

Gentlemen—Inclosed is a copy of a notice sent to every physician in this state requiring Infantile Paralysis and Cerebrospinal Meningitis to be reported to the local board of health.

Local boards of health must report all such cases to the State Board of Health upon the regular weekly report card furnished by this board for the reporting of certain communicable diseases, including Infantile Paralysis and Cerebrospinal Meningitis.

The suggestions of this board for the sanitary management of Infantile Paralysis, with the limited quarantine imposed, we believe to be sufficient for the restriction of the disease.

Suggestions for the care of Cerebrospinal Meningitis will be found in the forthcoming issue of the Quarterly Bulletin of the State Board of Health, which will be mailed very soon.

You will note the placards for the diseases required to be reported are furnished by this board upon application.

The attention of local boards of health is called to the fact that weekly reports are required during the prevalence of these diseases. Some boards are negligent in this respect.

We are also inclosing for the use of your board a copy of the principal Public Health laws of New Hampshire.

Very truly yours,
IRVING A. WATSON,
Secretary.

Inclosures.

REGULATION NO. 2, RELATING TO THE COMMON DRINKING CUP.

At a meeting of the State Board of Health on April 15, 1913, the following was adopted:

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WHEREAS, An order issued by the State Board of Health under the provisions of chapter 2, Laws of 1911, and made effective July 1, 1912, prohibiting the use of the common drinking-cup on railway trains, in railway stations, in public and private schools and at the state educational institutions, has demonstrated the practicability of doing away with a practice dangerous to public health, and

WHEREAS, Continued observation and investigation have proven beyond question that the common drinking-cup may convey disease of a most serious character, therefore, in the interests of public health, it is further

ORDERED, That on and after July 1, 1913, the use of the common drinking-cup is hereby prohibited in any public park, street or way, and in any building or premises used as a public institution, hotel, theatre, or public hall; provided that this regulation shall not be held to preclude the use of drinking-cups, glasses, or other vessels, that are thoroughly cleansed by washing in boiling water after each individual use; nor shall it be held to preclude the use of sanitary devices for individual use only.

Per order of the board,

IRVING A. WATSON,
Secretary.

AN ACT entitled "An Act to restrict the Use of Common Drinking Cups."

Be it enacted by the Senate and House of Representatives in General Court convened:

SECTION 1. In order to prevent the spread of communicable diseases the State Board of Health is hereby authorized to prohibit in such public places, vehicles, or buildings as it may designate the providing of a common drinking cup and the board may establish rules and regulations for this purpose.

SECT. 2. Whoever violates the provisions of this act, or any rule or regulation of the State Board of Health made under authority hereof, shall be deemed guilty of a misdemeanor and be liable to a fine not exceeding twenty-five dollars for each offense.

SECT. 3. All acts and parts of acts inconsistent herewith are hereby repealed.

SECT. 4. This act shall take effect on its passage.

Chapter 2, Laws of 1911.

The action of the State Board of Health in this matter was transmitted to every local board with the following letter:

THE STATE OF NEW HAMPSHIRE.
STATE BOARD OF HEALTH.
SECRETARY'S OFFICE, STATE HOUSE,
CONCORD, N. H., May 21, 1913.

To Local Boards of Health:

Enclosed herewith is a copy of Regulation No. 2, relating to the Common Drinking Cup, which will go into effect on July 1, 1913.

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You will note that the regulation is, in addition to regulations existing at the time of its promulgation, and that local boards of health are directed to enforce it in the same manner that they do other health regulations, in accordance with Section 2, Chapter 108, of the Public Statutes.

We suggest that your board notify, immediately, the proper authorities or prsons having charge of public parks, streets, public institutions, hotels, theatres and public halls concerning the requirements of this Regulation No. 2.

Bubbling drinking faucets can be very cheaply installed, or the individual paper cup may be provided, if preferred.

We desire, also, to request the co-operation of local boards of health in the enforcement of Chapter 15, Laws of 1911, relating to the Sanitary Production and Distribution of Food, copy of which is herewith enclosed. Your attention is called particularly to Section 2 of this act, and in the event you have knowledge of conditions contrary to the provisions of this act, we would request that you notify the offending party to comply with the law, and in the event of non-compliance after a reasonable time, that you report the case to this board.

We are also enclosing a copy of the principal Public Health Laws of New Hampshire for the convenience of your board.

Will you have the kindness to fill out the enclosed blank, giving the name and postoffice address of the present members of your board?

Thanking you for the courtesy, I remain,

Very truly yours,

IRVING A. WATSON,
Secretary.

REPORTING OCCUPATIONAL DISEASES.

AN ACT to Require the Reporting of Certain Occupational Diseases, and to Provide for Its Enforcement (Chapter 118, Laws of 1913).

SECTION 1. Every physician in this state attending on or called in to visit a patient whom he believes to be suffering from poisoning from lead, phosphorus, arsenic, brass, wood-alcohol, mercury or their compounds, or from anthrax, or from compressed-air illness, or any other ailment or disease, contracted as a result of the nature of the patient's employment, shall within forty-eight hours from the time of first attending such patient send to the State Board of Health a report stating:

(a) Name, address and occupation of patient. (b) Name, address and business of employer. (c) Nature of disease. (d) Such other information as may be reasonably required by the State Board of Health. The reports herein required shall be on or in conformity with the standard schedule blanks hereinafter provided for. The posting of the report, within the time required, in a stamped envelope addressed to the office of the State Board of Health, shall be a compliance with this section.

SECT. 3. *Reports not Evidence.* Reports made under this act shall not be evidence of the facts therein stated in any action arising out of the disease therein reported.

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SECT. 4. *Penalty.* Any physician who neglects or refuses to send the report or reports as herein required shall be liable to the state for a penalty of five dollars for each offense, recoverable by civil action by the State Board of Health.

Immediately following the passage of the act the secretary of the State Board of Health transmitted to every physician in the state and to the hospitals blanks for returns, the following of which is a copy. Upon the reverse side of the blank was printed a copy of the law and instructions for filling out the blank.

STATE BOARD OF HEALTH OF NEW HAMPSHIRE

CERTIFICATE OF INDUSTRIAL DISEASE.

Name of Patient.....
Address: Street and No.....City or Village.....

PERSONAL AND STATISTICAL PARTICULARS.

Sex.....Age.....Color.....Country of birth.....
Single, married, widowed or divorced (*write* the word).....
Occupation (a) Present trade, profession or work.....
.....
Particular kind of work in such trade, etc.....
.....
Date of entering present occupation.....
Employer's name .....
Address .....
Business (kind of goods made or work done).....
.....
(b) Previous occupations:

Name of occupation	Entered (year)	Left (year)
.....	.....	.....
.....	.....	.....
.....	.....	.....

Previous illnesses, if any, due to occupation:

Disease or illness	Year
.....	.....
.....	.....
.....	.....

MEDICAL CERTIFICATE OF DISEASE.

Diagnosis of present illness.....
Chief symptoms and conditions.....
.....
.....
.....

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Date first symptoms appeared.....
Complicating Diseases (such as alcoholism, syphilis, tuberculosis, etc.).....
.....
.....
.....
.....
Additional facts .....
.....
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.....
Date of diagnosis....., 191....
(Signed) ....., M. D.
....., 191.... (Address).....

Mail to State Board of Health, Concord, N. H.

Write Plainly with Ink—This is a Permanent Record.

N. B.—Every item of information should be carefully supplied The exact statement of OCCUPATION is very important. Physicians should state DIAGNOSIS in plain terms. See instructions on back of certificate.

INSTRUCTIONS FOR FILLING OUT CERTIFICATE.

IN GENERAL.—The *medical certificate* on the right hand side the physician alone can furnish. The *personal and statistical particulars* on the left-hand side must be secured by the physician either from the patient, or, in fatal cases, from the family precisely as for similar information in certificates of death sent to boards of health.

PRESENT OCCUPATION.—*Precise* statement of occupation is very important so that the relative healthfulness of various pursuits may be known. It is necessary to know both general trade or profession (for example, *printer* or *brass worker*) and also the particular kind of work or branch of the trade (as *hand compositor* or *linotype operator* for a printer, or *polisher or buffer* for a brass worker).

Date of entering present occupation is important to determine how long the worker may have been exposed to the hazard before contracting the disease.

Employer's name, address and business are necessary to ascertain distribution of occupational diseases by industries, many trades (*e. g.,* machinist's) being common to different industries.

PREVIOUS OCCUPATIONS need to be known, if possible, because present illness may be due to a former rather than present occupation, and industrial disease is frequently a cause of change of occupation. Give simply the name of each distinct occupation which the patient may have followed, with the year he entered and and the year he left.

PREVIOUS ILLNESSES.—This refers either to previous attacks of present disease, or to any other disease, *due to occupation.* All that is required is the name of each such disease or illness with the year in which it occurred. Such

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information, when it can be secured, will show whether the case reported is the first attack or not, and when combined with statement of previous occupations, will afford an outline history of the patient as to occupational disease.

MEDICAL CERTIFICATE.—Only the last two items specified for this require any explanation. In making these reports it is necessary to consider the possible influence of factors other than occupation as causes of the disease. For this reason any *complicating diseases* should be noted, such, for example, as alcoholism or syphilis in connection with arteriosclerosis in cases of lead or other metal poisoning. The possible effect of other factors, such as poor hygienic conditions in the home, or other personal conditions, must be considered, and when discoverable should be noted under *additional facts*.

IRVING A. WATSON, M. D.,
Secretary.

Blanks and instructions were transmitted with a letter as follows:

THE STATE OF NEW HAMPSHIRE.
STATE BOARD OF HEALTH.
SECRETARY'S OFFICE, STATE HOUSE,
CONCORD, N. H., October 29, 1913.

Dear Doctor:

The Legislature of 1913 enacted a law requiring "Occupational Diseases" to be reported to the State Board of Health. We are, therefore, inclosing blanks for that purpose, in accordance with the provisions of the law.

Upon the reverse side of the blank will be found extracts from the law and specific directions for making the returns.

When a person develops a disease from the work in which he is engaged, it is termed an "occupational disease." As an illustration: Lead poisoning in a painter would be an occupational disease; while lead poisoning from drinking water received through a lead pipe would not be classed under that head.

The purpose of the law is to make a study of industrial conditions that may affect the health of those who are engaged in the work. It will be noticed that the facts reported under this law cannot be used as evidence in any action arising out of the disease reported.

Additional blanks will be furnished upon request.

Very truly yours,
IRVING A. WATSON,
Secretary.

INCINERATOR FOR THE CITY OF DOVER.

The city of Dover has recently had constructed an incinerator for the destruction of garbage, which we are informed is entirely satisfactory in its operation. Its relative small cost combined with its efficiency would seem to commend it to the consideration of other

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cities in the state not already provided with satisfactory means of disposing of refuse.

Complete plans and specifications of this incinerator are on file in the office of the State Board of Health. Two half-tone illustrations of the structure are herewith shown.

Mr. H. K. Reynolds, health officer of the city of Dover, writes as follows:

By the establishment of its municipal incinerator during the past summer, the city of Dover is the first among New Hampshire cities and towns to recognize the necessity of providing a sanitary means for the disposal of its municipal refuse. The city dumps had been a nuisance for a considerable time, on account of their unsightly condition, and the much more serious objection to their being continued was the constant fire menace, which had caused some alarm to the city authorities on several occasions.

The desirability of an incinerating plant was recognized some years ago by the city officials, but it was supposed that a plant suitable for this city would be very expensive, both in first cost and in maintenance. Recent development of a new type of municipal incinerator brought out in Massachusetts three years ago by the Jarvis Engineering Company, and especially brought to the attention of the Dover authorities by the building of a plant for the town of Sanford, Maine, in 1912, placed on the market a very effective incinerator, which exactly meets the requirements of the smaller municipalities and is very inexpensive, both as to first cost and in operation.

The total cost of the installation at Dover, covering the building, substantial brick chimney and Jarvis-Morse Destructor Furnace, was $3,590. The foundations and floors are of concrete; the building, 29′ x 42′, is of corrugated galvanized iron, sides and roof on a substantial wood frame. The chimney is of brick, 24″ square inside by 60′ high. A location for the building was found, where but little grading needed to be done to arrange for convenient access to both the upper and lower floor level.

The Destructor Furnace is about 18′ long, 8′ wide and 8′ high. It is built of highly refractory fire brick throughout, heavily reinforced with red brick and structural steel bracing. There are a series of combustion and mixing chambers, whereby the temperature of the furnace is raised to a very high point, 1,500 to 1,800 degrees, and the gases and smoke thoroughly consumed before passing to the chimney. The furnace is fed through a top charging hole, 24″ in diameter, opening directly into the main combustion chamber. This arrangement is of the greatest convenience. Material is brought in wagons, dumped on the floor and introduced directly into the furnace through the charging hole. For the introduction of large boxes, crates, barrels, etc., large fire doors are placed at the front end of the furnace.

It was guaranteed by its builders to destroy 1,200 lbs. per hour of mixed combustible refuse and garbage. During tests made by the city authorities, the furnace has developed a much greater capacity than was guaranteed. All kinds of combustible refuse, wet and dry, have been put into the furnace in

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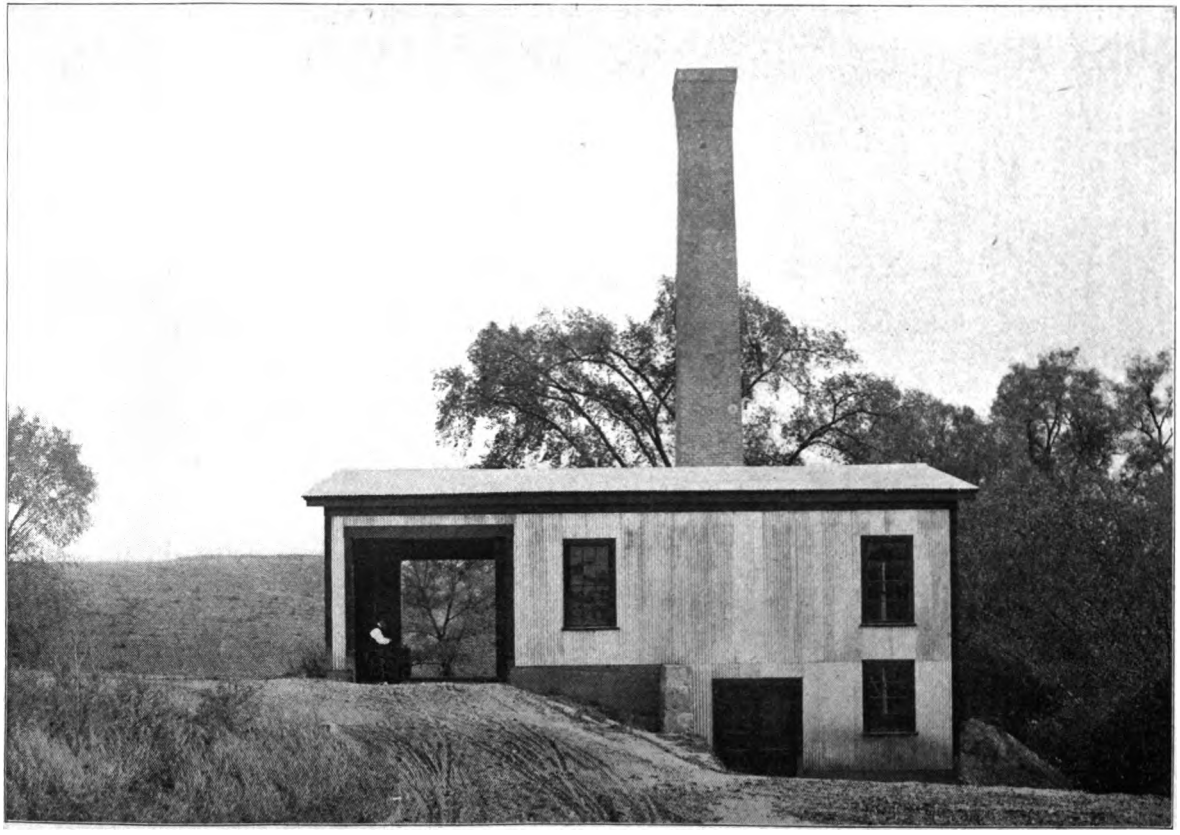

THE DOVER INCINERATOR.

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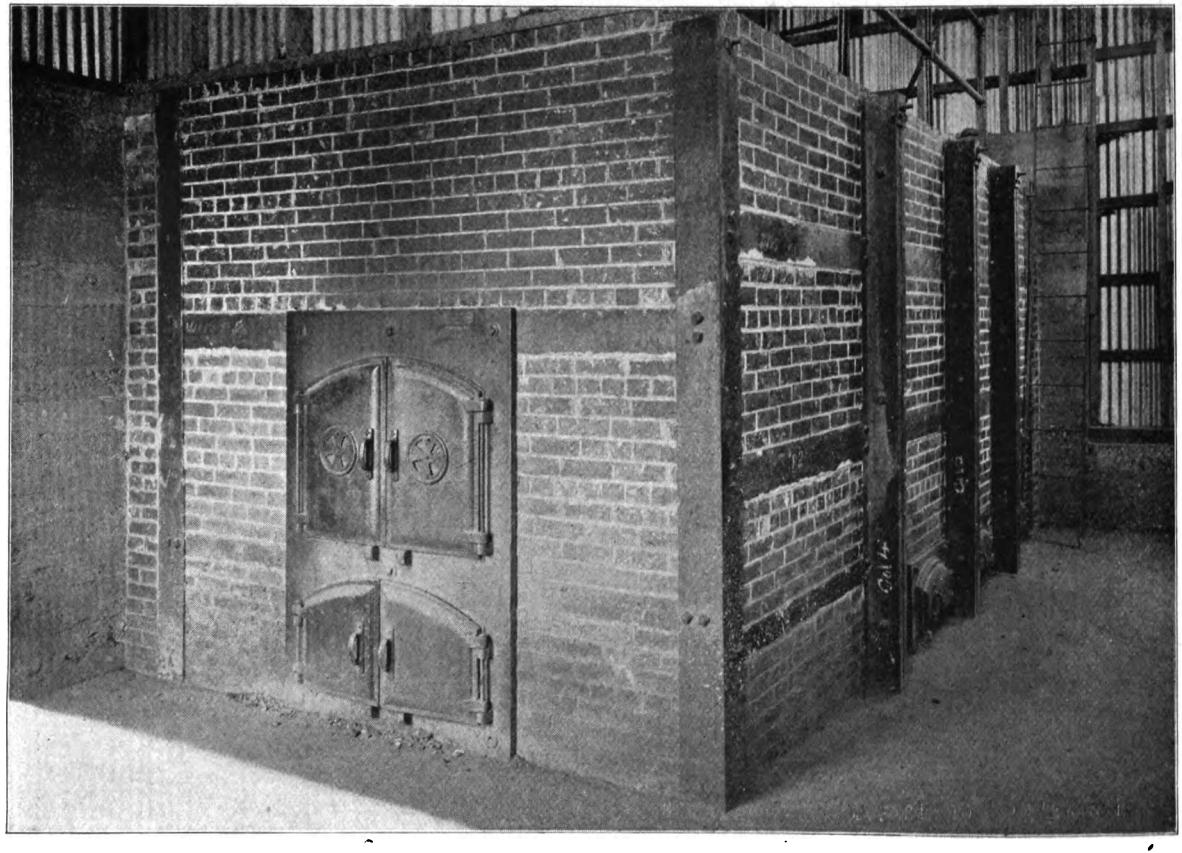

THE DOVER INCINERATOR (Interior View.)

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large quantities and satisfactorily consumed. Waste paper, boxes, garbage, store and market refuse, dead animals, etc., are all put into the incinerator.

There are no mechanical attachments or devices, such as forced draft blowers, to be operated in connection with the furnace. It requires the attention of one fireman when in operation. No additional fuel is required, so that the cost of operation is merely the expense of one fireman.

It has proved true in this city, as we understand has been the case in other places which have established municipal incinerators of this type, that there has been a tendency on the part of storekeepers and housholders to send refuse to the plant for destruction, instead of allowing it to accumulate around the premises. This is, of course, very desirable, as so many of our fires are caused by accumulation of waste material.

We wish to say that the incinerator has been entirely satisfactory, not only to the officials, but to the people in general.

INSPECTED MILK.

The legislature of 1911 enacted a measure providing for "Certified Milk" and "Inspected Milk," under certain conditions to be established by the State Board of Health. Following is a copy of the act:

AN ACT to provide for Certified and Inspected Milk.

Be it enacted by the Senate and House of Representatives in General Court convened:

SECTION 1. For the purpose of improving the dairy interests of the state of New Hampshire and for the better protection of public health, the State Board of Health may establish rules and regulations, under which may be produced and sold a grade of milk known as certified milk, and also a grade of milk known as inspected milk.

SECT. 2. No person shall exchange, or offer or expose for sale or exchange as and for certified milk or as and for inspected milk, any milk which does not conform to the regulations prescribed by the State Board of Health for each grade, or by a commission appointed by a county medical society, with the approval of the State Board of Health.

SECT. 3. All milk sold as certified milk or as inspected milk shall be conspicuously marked or labeled in accordance with the regulations of the State Board of Health, as provided in section 2, and must be produced from healthy, tuberculin-tested animals; must be free from antiseptics, added preservatives, pathogenic germs, and bacteria in excess of the established regulations.

SECT. 4. Any person who violates any of the provisions of this act, or the regulations established under it, shall be liable to a fine not exceeding ten dollars for each offense.

Approved April 6, 1911.

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Nearly two years passed after the enactment of law without any more being made to operate under its provisions. It was evident that an effort would have to be made to interest dairymen in its advantages else it would remain a dead letter. Therefore, early in 1913, the State Board of Health in coöperation with the dairy department of the State Board of Health in coöperation with the dairy department of the New Hampshire State College and local milk inspectors conceived the idea of inaugurating a movement to secure the production of "inspected milk." The New Hampshire Sanitary Milk Association was organized, with the choice of Prof. Fred Rasmussen, dairyman, New Hampshire Agricultural Experiment Station, as president, and Mr. Carl O. Seaman, milk inspector of Manchester, as secretary.

This association sent the following communication to the State Board of Health:

NEW HAMPSHIRE SANITARY MILK ASSOCIATION.

MANCHESTER, N. H., March 3, 1913.

Irving A. Watson, M. D.,
Secretary State Board of Health,
Concord, N. H.:

DEAR SIR—A sub-committee of the New Hampshire Sanitary Milk Association begs leave to submit the following outline of regulations for the production and sale of a high grade of milk:

The purpose of establishing a grade of milk known as "Inspected Milk" is to place before the medical profession and the consuming public a clean, wholesome milk, produced under conditions satisfactory to the State Board of Health.

Inspected Milk is milk drawn from healthy, tuberculin-tested cows in clean surroundings, free from antiseptics, added preservatives, pathogenic germs and bacteria not in excess of 100,000 per cubic centimeter.

A permit to produce Inspected Milk shall be in printed form, issued by the State Board of Health, the permit to be issued from January 1 to December 31 of each year, unless revoked for non-conformance with the requirements.

A receipt shall be given by the producer for the acceptance of the permit, which shall be kept on file in the office of the State Board of Health.

Inspected Milk shall not be above 50 degrees Fahrenheit when delivered to the customer or prior thereto.

All cows shall be tuberculin tested annually by a veterinary physician approved by the State Board of Health, and all cows reacting shall be removed from the herd. No additions shall be made to the herd unless the animals are free from tuberculosis.

All scores of equipment and methods used in handling this milk shall be filed with the State Board of Health and with the local board of health.

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Premises must be whitewashed or painted and disinfected at least once a year.

Persons having actual charge in the enforcement of these regulations shall be required to take a practical examination before a person or persons designated by the State Board of Health, in order that their fitness for this duty may be ascertained.

The State Board of Health shall furnish to the producers, at cost, parchment paper covers inscribed with the words "Inspected Milk," the seal of the State Board of Health, and the year for which the permit is issued.

Respectfully submitted,

CARL O. SEAMAN,
Secretary.

At a meeting of the board at the state house, on Tuesday, April 15, 1913, the following statement and requirements were adopted, subject to such amendments as may seem desirable after a further consideration of the subject:

INSPECTED MILK.

License for the production and sale of "Inspected Milk" may be granted by the State Board of Health for a period not exceeding one year after an inspection of the premises where the said milk is to be produced by a representative of the State Board of Health, and after all the requirements promulgated by the board have been provided for, and all of the conditions have been agreed to in writing by the producer.

When all of the conditions and requirements have been met to the satisfaction of the State Board of Health, the latter board may issue a license to use the term "Inspected Milk," and shall furnish milk-bottle caps with such inscription, statement or design as may be decided upon, the same to be paid for by the producer.

The purpose of the procedure is to secure a reasonably clean, safe and healthful milk of a high grade, because produced under strict supervision and better conditions than is usual.

The following, briefly stated and without elaboration of details, are the conditions under which such milk may be produced and sold:

STABLES.

Stables shall be kept well whitewashed, ventilated, and reasonably clean.

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The walls shall be whitewashed, unless their construction renders it unnecessary, and they shall be kept free from cobwebs, dirt, etc.

The manure should be removed at least twice daily, and proper bedding should be provided to keep the animals reasonably clean.

COWS.

Physical examination shall be made of the cows at least twice a year by a veterinarian approved by the State Board of Health. The tuberculin test shall be applied at least once a year, and any cows reacting shall be promptly removed from the herd.

No new cows shall be added until after they have passed the tuberculin test and a physical examination by a veterinary surgeon approved by the State Board of Health.

Cows, and especially their udders, shall be clean at the time of milking.

MILK-ROOM.

A milk-room that is clean, light and screened shall be provided for the cooling, bottling and storing of the milk and the operations incident thereto.

EMPLOYEES.

All employees connected in any way with the handling of the milk shall be personally clean and free from any communicable disease.

The health authorities shall be notified at once if any communicable disease appears in any person having to do with the handling of the milk, or in the family of the milk-man or producer. Under such circumstances, no milk shall be disposed of until officially authorized in writing.

UTENSILS.

All utensils and apparatus with which the milk comes in contact shall be thoroughly washed, and sterilized with boiling water or steam, and shall be used for no other purpose than that for which they were designed.

No milk bottles shall be removed from a house in which there is or recently has been a case of communicable disease until official permission is granted.

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Small-top milk pails shall be used.

No unwholesome food or food liable to taint the milk shall be fed to the cows.

MILK.

The milk shall not be strained in the cow stable, but shall be removed to the milk-room immediately after it is drawn. It shall be cooled to 50° Fahrenheit, or below, immediately after it is drawn from the cow, and shall be kept at that temperature until it is delivered to the consumer.

The milk shall be delivered in single-service containers, unless special permission for other method of delivery is granted.

The milk shall not contain bacteria in excess of 100,000 per cubic centimeter, and must be entirely free from pathogenic germs.

INSPECTIONS.

Inspections will be made from time to time by inspectors designated by the State Board of Health. No person will be appointed as inspector who has not first obtained a certificate from the superintendent of the dairy department of the New Hampshire College of Agriculture showing the holder to be qualified to perform the duties imposed under the regulations. Samples of the milk for chemical and bacteriological examination may be taken at any time. License to use the term "Inspected Milk" may be revoked at any time for non-compliance with the regulations established by the State Board of Health.

IRVING A. WATSON,
Secretary.

It should be noted that already a large amount of milk inspection work has been done by the State Board of Health through an inspector of the State Board of Health, in coöperation with the regularly appointed local inspectors or the local boards of health in all of our cities and in many of the towns in the state. It was not difficult therefore to select some dairies that might be willing to accede to the requirements of the regulations established by the State Board of Health for the production of "Inspected Milk."

The work of inspection covers many details in connection with the milk business, and in order to record all the particulars necessary

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to be taken into consideration, a score card is provided, copy of which is herewith given.

STATE OF NEW HAMPSHIRE.
STATE BOARD OF HEALTH.

SANITARY INSPECTION OF DAIRIES.

Equipment	40 per cent.	Score.....per cent.
Methods	60 per cent.	Score.....per cent.
Perfect Dairy	100 per cent.	Score.....per cent.

Inspection No......**Time**.....A. P. M. **Date**.....191...
Dairyman .....
P. O. Address.....
Party Interviewed .....
Operated by .....
Milk delivered to Milk Station.....
No. Cows.....No. Milking.....No. Qts. Produced.....
All persons in the households of those engaged in producing or handling milk are.....
.....free from all infectious disease.
Date and nature of last case on farm.....
Water Supply for utensils is from a.....located.....feet deep
and apparently is.....pure and wholesome.....
State any possible contamination located within 200 feet of source of water supply or if water supply is not protected against surface drainage.....
.....
.....
Water supply on this farm analyzed.....191... Result.....
Style of Cow Barn.....Length.....ft. Width.....ft. Height of ceiling.....ft.
Dairy Herd examined by.....on.....191... Report.....

EQUIPMENT

	Perfect	Allow
Cow Stable is.....located on elevated ground, with no stagnant water, hog-pen, privy, uncovered cesspool or manure pit within 100 feet	1	.....
Floors, other than cow beds, are.....of concrete or some non-absorbent material	2	.....
Floors are.....properly graded and water-tight	2	.....
Cow Beds are.....of concrete or planks laid on concrete	2	.....
Drops are.....constructed of concrete, stone or some non-absorbent material	2	.....
Drops are.....water-tight and space beneath is clean and dry	2	.....
Ceiling is constructed of.....and is.....tight and dust-proof	2	.....
Windows No.....total square feet.....there is.....2 square feet of window light for each 600 cu. ft. air space (1 sq. ft. per 600 cu. ft.—1)	2	.....
Ventilation consists of.....sq. ft. muslin covered openings or .....sq. ft. open chutes in ceiling or.....which is sufficient 3, fair 2, poor 1, insufficient 0	3	.....
Air Space is.....cu. ft. per cow (600 and over—3) (500 to 600—2) (400 to 500—1) (under 400—0)	3	.....
Live Stock, other than cows, are.....excluded from rooms in which milch cows are kept	2	.....
There is.....direct opening from stable into silo or grain pit	1	.....
Separate quarters are.....provided for cows when calving or sick	1	.....
Cow Yard.....is properly graded and drained	2	.....
Water Supply for cows is.....unpolluted and plentiful	1	.....
Milk House has.....direct opening into cow barn or other building	1	.....
Milk house has.....sufficient light and ventilation	1	.....
Floor is.....properly graded and water-tight	1	.....
Milk house is.....properly screened to exclude flies	1	.....
Milk Pails are.....of smoothly tinned metal in good repair	1	.....
Milk pails have.....all seams soldered flush	1	.....
Milk pails are.....of the small mouthed design, top opening not exceeding 8 inches in diameter. Diameter	4	.....
Racks are.....provided to hold milk pails and cans when not in use	1	.....
Special Milking Suits are.....provided	1	.....
	40	

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METHODS.

	Perfect	Allow
Stable Interior painted or whitewashed on.....which is saistfactory 3, fair 2, unsatisfactory 1, never 0.....	3	.....
Feeding Troughs, platforms or cribs are.....well lighted and clean..	1	.....
Ceiling is.....free from hanging straw, dirt or cobwebs.....	1	.....
Window Panes are.....washed and kept clean.....	1	.....
Walls and Ledges are.....free from dirt, dust, manure or cobwebs	2	.....
Floors and Premises are.....free from dirt, rubbish or decayed animal or vegetable matter.....	2	.....
Cow Beds are.....clean, dry and no horse manure used thereon	2	.....
Manure is.....removed to field daily 4, to at least 100 feet from barn 2, stored less than 100 feet or where cows can get at it 0	4	.....
Liquid Matter is.....allowed to saturate ground under or around cow barn.....	2	.....
Milking Stools are.....clean.....	1	.....
Cow Yard is.....clean and free from manure.....	2	.....
Cows have.....been tuberculin tested and all tuberculous cows removed.....	7	.....
Cows are.....all in good flesh and condition at time of inspection	2	.....
Cows are.....all free from clinging manure and dirt. (No. dirty.....)	4	.....
Long Hairs are.....kept short on belly, flanks, udder and tail....	1	.....
Udder and Teats of cows are.....thoroughly brushed and wiped with a clean damp cloth before milking.....	3	.....
All Feed is.....of good quality and distillery waste or any substance in a state of putrefaction is.....fed.....	2	.....
Milking is.....done with dry hands.....	2	.....
Fore Milk of first few streams from each teat is.....discarded.....	2	.....
Clothing of Milkers is.....clean.....	1	.....
Facilities for washing hands of milkers are.....provided in cow barn or milk house.....	2	.....
Milk is strained at.....and.....in clean atmosphere.....	1	.....
Milk is.....cooled within two hours after milking to 50 degrees F. 3; to 55 degrees F. 2; to 60 degrees F. 1.....	3	.....
Ice is.....used for cooling milk.....	1	.....
Milk House is.....free from dirt, rubbish and all material not used in the handling and storage of milk.....	2	.....
Milk Utensils are.....rinsed with cold water immediately after using and washed clean with hot water and washing solution....	2	.....
Utensils are.....sterilized by steam or boiling water after each using	2	.....
Privy is.....in sanitary condition, with vault and seats..... covered and protected.....	1	.....
	60	

Remarks .....

.....

Duplicate Score Sent.....19....

....

Inspector.

After all of the requirements have been complied with and agreed to over the signature of the proprietor of the dairy, a license is issued to him to produce and sell inspected milk, for a period of one year. Milk caps designed for his especial use are furnished to him at cost, showing that he has been licensed by the State Board of Health.

In order to know that the requirements are lived up to, samples of milk are taken from the delivery wagon monthly, or as often as desired by the State Board of Health, and submitted to the State Laboratory of Hygiene for bacterial and other examinations, and a report is made to the local milk inspector or to the local board of health, as the case may be, and also to the dairy. Following is a copy of the report card used, with an explanation of the method of marking; also a sample milk cap.

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STATE OF NEW HAMPSHIRE.
STATE BOARD OF HEALTH.

SCORE CARD FOR INSPECTED MILK.

Name of Dairy Farm.....
Location .....
Proprietor .....
P. O. Address.....
Date of Collection.....Taken from.....
Collected by .....
TEMPERATURE SAMPLE No. 1.....No. 2.....

ITEM	Possible Maximum Score	No. 1 Score Allowed	No. 2 Score Allowed
Bacteria	50	.....	.....
Flavor and Odor.....	15	.....	.....
Visible Dirt	25	.....	.....
Acidity	5	.....	.....
Bottle and Cap.....	5	.....	.....
Total	100	.....	.....

REMARKS.

Bacteria found per cubic centimeter—No. 1.....
Bacteria found per cubic centimeter—No. 2.....
Flavor .....
Odor .....
.....
Per cent found.....
Cap .....
Bottle .....
.....*Bacteriologist.*
.....*Secretary.*

NOTE—The above is a sanitary rating only, and does not include total solids or fat content. Any milk found to be below the standard required by law will constitute sufficient cause for the cancellation of license, and for legal procedure against the producer or vendor.

DIRECTIONS FOR SCORING INSPECTED MILK.

BACTERIA PER CUBIC CENTIMETER—PERFECT SCORE, 50.

	Points		Points
3,000 or less	50	40,001 to 45,000	39
3,001 to 4,000	49.5	45,001 to 50,000	38
4,001 to 5,000	49	50,001 to 55,000	37

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	Points.		Points.
5,001 to 6,000	48.5	55,001 to 60,000	36
6,001 to 7,000	48	60,001 to 65,000	35
7,001 to 8,000	47.5	65,001 to 70,000	34
8,001 to 9,000	47	70,001 to 75,000	33
9,001 to 10,000	46	75,001 to 80,000	32
10,001 to 15,000	45	80,001 to 85,000	31
15,001 to 20,000	44	85,001 to 90,000	30
20,001 to 25,000	43	90,001 to 95,000	29
25,001 to 30,000	42	95,001 to 100,000	28
30,001 to 35,000	41	Over 100,000	0
35,001 to 40,000	40		

NOTE—When the number of bacteria per cubic centimeter exceeds 100,000 the score shall be 0.

FLAVOR AND ODOR—PERFECT SCORE, 15.

Deductions for disagreeable or foreign odor or flavor should be made according to conditions found. When possible to recognize the cause of the difficulty it should be described under Remarks.

VISIBLE DIRT—PERFECT SCORE, 25.

Examination for visible dirt should be made only after the milk has stood for some time undisturbed in any way. Raise the bottle carefully in its natural, upright position, without tipping, until higher than the head. Observe the bottom of the milk with the naked eye or by the aid of a reading glass. The presence of the slightest movable speck makes a perfect score impossible. Further deductions should be made according to the amount of dirt found. When possible, the nature of the dirt should be described under Remarks.

ACIDITY—PERFECT SCORE, 5.

	Points		Points
0.2 per cent and less	5	0.23 per cent	2
0.21 per cent	4	0.24 per cent	1
0.22 per cent	3	Over 0.24 per cent	0

BOTTLE AND CAP—PERFECT SCORE, 5.

Bottles should be made of clear glass and free from attached metal parts. Caps should be sealed in their place with hot paraffin, or both cap and top of bottle covered with parchment paper or other protection against water and dirt. Deduct for tinted glass, attached metal parts, unprotected or leaky caps, partially filled bottles, or other conditions permitting contamination of milk or detracting from the appearance of the package.

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BACTERIOLOGICAL DEPARTMENT.

By Charles Duncan, M. D., *Bacteriologist.*

Following is a report of the bacteriological department of the State Laboratory of Hygiene for the two fiscal years ending August 31, 1914:

During the period named, 8,235 examinations were made, under the following classifications:

Table No. 1.

Sputum	3,567
Throat cultures	3,360
Widal reaction, for typhoid	845
Suspected gonorrhœa	342
Miscellaneous*	140
Total	8,254

The above table does not include bacteriological examinations of water supplies or inspected milk, as these results are given in the chemist's report.

It will be seen by the table that the greater part of the work was in making routine clinical examinations for physicians, chiefly in suspected cases of diphtheria, typhoid and tuberculosis. Investigations, however, are made willingly of any conditions connected with public health questions. Research work in the line of original investigations will be undertaken if conditions warrant it.

To be of the greatest possible aid to physicians in clinical work, bacteriological outfits must be so distributed throughout the state as to be of easy access. They are furnished free, and are distributed by drug stores in the various towns and cities, as well as by some boards of health, for the use of all physicians.

These outfits are such as have been approved by the postoffice authorities, and no other can be used under Federal regulations. There should be no lack of outfits in any town. Druggists should see that their supply is not exhausted. In localities where there is no depository, outfits are mailed directly to physicians upon request. It is the purpose of the department to have supplies kept within convenient

*Under Miscellaneous examinations are included malaria, glanders, tissue examinations for tuberculosis, urines for typhoid bacilli, pus, and some unusual conditions to determine clinical questions.

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reach of physicians, and to do this the coöperation of druggists and of physicians themselves is at all times necessary.

The laboratory will put up, for immediate forwarding, packages containing fifty or more outfits, to be used in taking cultures from the throats of school children.

The number of outfits sent out for the use of physicians very largely exceeds the number returned to the laboratory, which seems to show a lack of economical care in this respect. We state this fact trusting that greater care may be exercised against the loss, which entails considerable expense upon the laboratory.

Tuberculosis.

During the period covered by the report, 3,567 specimens of sputum in suspected cases of tuberculosis were examined, a slight decrease over previous like period. Of these, 679 or 19 per cent., were found to contain the tubercle bacillus.

Table II.

Table II shows the number of specimens received from the different towns and cities. It is a noticeable fact that when influenza, cold and coughs are prevalent, the laboratory receives fewer tuberculosis specimens, yet this very time is especially favorable for the discovery of the tubercle bacillus, as in some instances, at least, it may be the primary cause of the so-called cold or cough.

TABLE II.—TUBERCULOSIS.

	Positive.	Negative.	Total.	Duplicate.
Allenstown	0	3	3	0
Alstead	2	16	18	3
Alton	0	4	4	0
Amherst	1	0	1	0
Andover	0	4	4	0
Antrim	0	1	1	0
Ashland	1	26	27	3
Bennington	3	1	4	0
Bartlett	3	30	33	0
Bath	0	4	4	0
Belmont	3	3	6	0
Berlin	18	81	99	6
Bethlehem	2	5	7	0

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	Positive.	Negative.	Total.	Duplicate.
Boscawen	2	4	6	0
Barnstead	0	14	14	0
Bradford	1	5	6	0
Bristol	7	4	11	0
Brooklyn	1	3	4	0
Campton	0	1	1	0
Canaan	0	4	4	0
Centre Harbor	0	3	3	0
Charlestown	2	10	12	0
Chester	0	1	1	0
Claremont	10	44	54	0
Colebrook	5	21	26	0
Concord	57	331	388	20
Conway	5	32	37	13
Derry	3	13	16	2
Dover	41	144	185	13
Durham	0	4	4	0
Eaton	0	1	1	0
Enfield	2	14	16	0
Epsom	1	8	9	0
Epping	3	7	10	0
Exeter	9	68	77	11
Farmington	1	20	21	3
Fitzwilliam	5	22	27	4
Franconia	3	12	15	0
Franklin	16	99	115	20
Freedom	2	5	7	0
Fremont	2	2	4	0
Gerrish	3	1	4	0
Goffstown	3	10	13	0
Grasmere (County Farm)	45	97	142	23
Gorham	4	9	13	1
Greenfield	2	7	9	0
Greenland	0	6	6	0
Greenville	2	6	8	0
Groveton	1	12	13	0
Hampton	2	5	7	0
Hanover	8	114	122	0

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	Positive.	Negative.	Total.	Duplicate.
Haverhill	6	29	35	1
Hudson	0	5	5	0
Hillsborough	4	16	20	0
Hinsdale	0	4	4	0
Hill	0	2	2	0
Hollis	0	4	4	0
Hooksett	3	4	7	1
Keene	25	110	135	24
Kingston	1	2	3	0
Laconia	13	33	46	1
Lancaster	4	13	17	0
Lebanon	14	39	53	12
Lempster	0	2	2	0
Lincoln	0	12	12	2
Lisbon	6	25	31	4
Littleton	11	85	96	17
Loudon	2	1	3	0
Lyme	0	14	14	2
Madison	0	1	1	0
Manchester	126	449	575	42
Marlow	0	1	1	0
Meredith	7	7	14	2
Meriden	1	1	2	0
Milford	11	22	33	3
Milton	0	3	3	0
Nelson	0	1	1	0
Nashua	42	159	201	31
New Boston	2	11	13	2
New Hampton	0	3	3	0
New London	1	7	8	0
Newmarket	5	5	10	1
Newport	8	27	35	4
Northwood	1	3	4	0
Nottingham	0	0	0	0
Orford	1	2	3	0
Peterborough	0	19	21	6
Pittsfield	0	4	4	0
Plaistow	2	4	6	0

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	Positive.	Negative.	Total.	Duplicate.
Plymouth	5	32	37	9
Portsmouth	26	125	151	25
Raymond	0	2	2	0
Rochester	7	14	21	0
Rumney	0	9	9	0
Salem	2	2	4	0
Salisbury	0	0	0	0
Sanbornville	2	3	5	0
Sandwich	1	9	10	1
Somersworth	20	49	69	7
Stewartstown	4	10	14	2
Stratton	0	2	2	0
Sunapee	1	2	3	0
North Stratford	2	5	7	0
Sutton	1	3	4	0
Swanzey	2	3	5	0
Temple	4	1	5	4
Tilton	5	11	16	5
Troy	2	15	17	4
Wentworth	1	1	2	0
Unity	0	4	4	0
Walpole	1	9	10	0
Warner	0	1	1	0
Warren	0	1	1	0
Whitefield	3	26	29	0
Wilton	2	12	14	0
Winchester	1	2	3	0
Woodsville	6	25	31	5
Wolfeboro	2	10	12	0
Out of state	2	31	33	6
Totals	679	2,888	3,567	338

Of the 678 cases in which the sputum was found to contain tubercle bacilli, 584 were from patients whose ages were given by the physicians as classified in Table III.

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TABLE III—SHOWING AGE AND SEX OF 732 POSITIVE CASES OF TUBERCULOSIS.

Ages.	Males.	Females.	Total.
0 to 10	2	2	4
11 to 15	3	7	10
16 to 20	20	36	56
21 to 30	101	91	192
31 to 40	89	65	154
41 to 50	50	40	90
51 to 60	22	12	34
61 years and over	23	11	34
Total	310	264	574

The above table shows most emphatically the ravages of tuberculosis, in that it takes from the community a large percentage of its victims at the most productive period of life. This is even more vividly shown in Table IV, by percentages.

TABLE IV.—PERCENTAGES OF CASES OF TUBERCULOSIS BY AGE PERIODS.

Ages.	Percentages.
0 to 20	12
21 to 40	64.9
41 years and over	23.1

The reports of the physicians at the time of sending the specimens to the laboratory showed that 345 of the patients were at that time unable to perform any labor, while 132 were at work. The condition of 97 in this respect was not stated.

DIPHTHERIA.

The total number of throat cultures examined was 3,350; of these 518 contained diphtheria bacilli. The number of cultures received from the different cities and towns is shown in Table V.

TABLE V.

	Positive.	Negative.	For Diagnosis.	For Release.	Not Stated.
Alstead	0	7	0	0	7
Alton	0	1	1	0	0
Amherst	2	14	6	10	0
Antrim	2	7	5	0	4

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	Positive.	Negative.	For Diagnosis.	For Release.	Not Stated.
Andover	1	8	8	1	0
Ashland	0	6	6	0	0
Barnstead	0	3	3	0	0
Bartlett	0	7	7	0	0
Belmont	0	2	2	0	0
Berlin	29	80	49	60	0
Bethlehem	0	2	2	0	0
Bradford	0	1	1	0	0
Bristol	0	5	5	0	0
Brookline	1	1	0	0	2
Canaan	2	3	3	2	0
Charlestown	9	12	9	12	0
Chester	1	10	2	9	0
Claremont	18	60	40	38	0
Concord	88	884	540	202	230
Colebrook	1	4	3	1	1
Conway	37	103	75	57	8
Center Harbor	0	5	5	0	0
Dover	3	20	23	0	0
Derry	7	42	36	13	0
Deerfield	0	0	0	0	0
Exeter	13	32	33	12	0
Epping	0	6	6	0	0
Epsom	0	2	2	0	0
Farmington	4	14	15	3	0
Fitzwilliams	2	2	2	2	0
Franconia	3	14	13	4	0
Franklin	34	112	87	59	0
Freedom	0	1	1	0	0
Goffstown	0	18	18	0	0
Gorham	1	4	3	2	0
Gilsum	1	0	1	0	0
Grantham Hill	3	7	3	7	0
Grasmere	1	3	1	3	0
Greenland	0	5	5	0	0
Greenfield	5	8	4	9	0
Greenville	0	1	1	0	0

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	Positive.	Negative.	For Diagnosis.	For Release.	Not Stated.
Groveton	0	7	5	2	0
Hampstead	0	5	5	0	0
Hanover	0	21	21	0	0
Haverhill	1	3	4	0	0
Henniker	4	14	6	12	0
Hinsdale	0	8	7	0	1
Hillsborough	3	23	20	6	0
Hollis	0	9	9	0	0
Hopkinton	0	1	1	0	0
Hudson	1	3	4	0	0
Jaffrey	0	3	2	0	1
Jackson	2	6	3	5	0
Keene	7	70	60	13	4
Hooksett	2	3	2	3	0
Laconia	2	15	16	1	0
Lakeport	0	0	0	0	0
Lancaster	2	14	14	2	0
Lebanon	14	42	28	18	10
Littleton	39	206	151	94	0
Lincoln	2	3	2	3	0
Lisbon	5	8	8	5	0
Londonderry	0	2	2	0	0
Loudon	8	5	6	7	0
Lyme	1	2	3	0	0
Manchester	35	280	228	74	13
Madison	0	6	3	3	0
Meriden	0	1	1	0	0
Meredith	0	2	2	0	0
Milton Mills	8	13	11	10	0
Milford	24	62	37	45	4
Nashua	30	140	60	107	3
New Boston	0	6	6	0	0
New London	1	3	2	2	0
Newmarket	0	0	0	0	0
Newport	7	38	26	11	8
Northwood	0	2	1	1	0
Orford	0	2	2	0	0

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	Positive.	Negative.	For Diagnosis.	For Release.	Not Stated.
Pike	0	1	0	1	0
Plaistow	0	3	2	1	0
Plymouth	0	9	6	1	2
Portsmouth	16	69	30	52	3
Rochester	9	76	44	38	3
Troy	0	4	4	0	0
Rumney	0	3	0	0	3
Salem	2	1	1	0	2
Somersworth	2	8	8	2	0
Stewartstown	1	1	2	0	0
Stratford	0	1	1	0	0
Suncook	0	8	7	1	0
Sutton	0	2	1	1	0
Swanzey	1	1	2	0	0
Tilton	0	6	5	1	0
Tuftonborough	0	4	0	4	0
Unien	0	3	3	0	0
Walpole	3	14	9	6	2
Warner	0	13	13	0	0
Warren	0	2	2	0	0
Whitefield	2	5	7	0	0
Wilton	3	19	3	3	16
Winchester	9	20	15	0	14
Weare	0	1	0	1	0
Wolfeboro	2	7	6	3	0
Wakefield	1	4	5	0	0
Woodsville	0	7	0	6	1
White River Jct., Vt.	0	2	2	0	0
Wakefield	1	4	5	0	0
Total	518	2,842	1,967	1,051	342

The following table shows the laboratory results in 1,235 cases in which the attending physician made a definite statement of diagnosis from clinical symptoms only:

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TABLE VI.

Clinical Diagnosis.	Total cases.	Laboratory Examination. Positive.	Negative.
Diphtheria	267	180	87
Not Diphtheria	860	83	777
Doubtful	108	23	85
	1,235	286	949

The following table exhibits by percentages the difference between the clinical diagnosis and the results of the laboratory examination:

TABLE VII.

Clinical Diagnosis.	Laboratory Examination. Percentages. Positive.	Negative.
Diphtheria	64.4	35.6
Not Diphtheria	3.5	96.5
Doubtful	21.2	78.8

These figures demonstrate what has been proven over and over again, namely, that it is absolutely impossible to make a correct diagnosis in many, and perhaps in most, cases of throat infection from the clinical symptoms alone.

Frequently an exudate is present when the culture is negative so far as diptheria is concerned. Of the cases with a clinical record of exudate or membrane, 38 per cent. proved positive in culture; while of the cases with a clinical record of no exudate or membrane, 14 per cent, proved to be positive diphtheria in culture. This would appear to indicate that antitoxin should be administered in cases in which an exudate or a membrane is present, and that the case should be held as "suspicious" until at least three negative laboratory reports have been obtained.

Before making cultures from the swab, an examination by smear is always made for the diphtheria bacillus, and yields results in approximately 45 per cent. of cases, with a saving of time of from 14 to 16 hours in making a report.

Typhoid Fever.

The laboratory examined 836 specimens of blood for the Widal reaction 135 were positive. The table following shows cities and towns from which specimens were received.

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The strains of typhoid bacilli used for Widal are from different sources, and several different strains are used on same sample of blood but we find that the percentage of positives remains the same. Occasionally differences in the power of some bloods to clump the different strains are noticed. If sufficient blood is sent to the laboratory in the container a bile growth is made from the clot but here again the percentage of positives remains the same.

Of the 135 cases reported positive, 67, about one half, the doctor made a positive diagnosis of typhoid fever and the other half did not state any opinion as to diagnosis.

Of the 701 cases reported negative, 312 stated the case to be one of typhoid fever; 389 did not give any opinion as to diagnosis.

TABLE VIII.

	Positive Widal Reaction.	Negative Widal Reaction.
Doctor's diagnosis typhoid	67	312
Doctor's diagnosis not stated	68	389

The above table shows that in about one half the cases sent to the laboratory for the Widal reaction the diagnosis of laboratory is at variance with the diagnosis written on the card, and *vice versa*. It is difficult to harmonize this fact with our knowledge of the value of the Widal reaction but we surmise that, considering the actual number of cases of typhoid fever reported to the State Board of Health, that the laboratory finds positive Widal reactions in the requisite number of bloods sent from actual cases as they afterwards develop.

TABLE IX.—TYPHOID FEVER.

	Positive.	Negative.	Total.
Amherst	0	1	1
Alstead	0	3	3
Andover	0	2	2
Antrim	4	8	12
Ashland	0	4	4
Bartlett	1	4	5
Belmont	5	4	9
Bennington	5	4	9
Bath	2	1	3
Berlin	0	5	5
Bristol	0	3	3

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	Positive.	Negative.	Total.
Bradford	0	2	2
Candia	2	8	10
Center Harbor	0	1	1
Charlestown	1	5	6
Claremont	7	29	36
Concord	11	105	116
Conway	1	7	8
Derry	2	4	6
Dover	0	19	19
Durham	0	7	7
Enfield	2	2	4
Exeter	3	18	21
Francestown	0	1	1
Franklin	1	15	16
Farmington	6	16	22
Gorham	0	3	3
Gilsum	0	2	2
Goffstown	0	4	4
Grasmere	0	5	5
Greenville	0	2	2
Groveton	2	6	8
Hanover	13	29	42
Hudson	0	1	1
Londonderry	0	2	2
Henniker	0	2	2
Hillsborough	0	11	11
Hinsdale	2	5	7
Hooksett	0	2	2
Keene	8	48	56
Laconia	0	9	9
Lancaster	2	4	6
Lebanon	2	8	10
Lisbon	1	14	15
Littleton	2	9	11
Meriden	0	2	2
Milan	1	1	2
Milford	1	3	4
Milton	0	2	2
Nashua	3	17	20

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	Positive.	Negative.	Total.
Manchester	19	92	111
New Boston	1	5	6
New London	1	3	4
Newmarket	0	1	1
Newport	0	6	6
Pittsfield	0	1	1
Northwood	0	1	1
Peterborough	1	0	1
Plymouth	3	19	22
Portsmouth	4	38	42
Raymond	0	1	1
Rochester	0	1	1
Sandwich	0	4	4
Somersworth	7	11	18
Stewartstown	0	1	1
Stratford	0	1	1
Suncook	0	1	1
Sutton	0	2	2
Troy	0	2	2
Union	1	0	1
Washington	0	2	2
Walpole	3	4	7
Warner	0	1	1
White River Junction (Lebanon)	3	4	7
Wilton	3	13	16
Winchester	0	5	5
Wolfeboro	0	8	8
Woodsville	2	6	8
Whitefield	2	3	5
Total	140	705	845

GONORRHEA.

Three hundred forty-two specimens of pus mostly from genital organs, a few from the eye, were examined for gonococci. One hundred and eight (51.8 per cent.) were found to be positive. The laboratory calls the case positive only when the diplococcus is found within the pus cell and is responsive to Grams stain. The greater number of the positive specimens were in males between the age of 20 and 30.

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Only 48 were from females. Twenty were from children under ten years of age. Fourteen were from the eye.

The number of towns that make use of the laboratory for this test are still too few—only thirty in number—an increase over last year, but we can hardly believe that it is generally understood that this test is made by the laboratory free of charge and that a regulation outfit is furnished. It is advisable that more physicians take advantage of this test examination. There is such a thing as a urethritis due to bacteria other than the gonococcus and the patient should have the benefit of the doubt.

TABLE X.

No. of Examinations.	Positive.	Negative.
342	108	134
Eye Specimens.	**Urethral.**	**Vaginal.**
20	264	48.

Infectious Diseases of Animals.

The laboratory is frequently called upon to examine specimens from animal sources, this includes, besides milk already mentioned, tissues of various kinds, pus and other discharges from diseased cattle, sheep, fowls and swine. Eight specimens showed the presence of tubercle bacilli; six revealed the presence of parasites, and ten of inflammation. Examinations for glanders are frequently made in the laboratory through inoculation of Guinea pigs from specimens of the product received. The laboratory has no outfit designed especially for the collection of specimens from glandered horses, but the ordinary diphtheria outfit, which can be obtained at any supply station, answers every purpose.

Typhoid Urines.

The laboratory is always ready to make urinary examinations in cases suspected of being typhoid bacilli carriers. Twelve such cases were examined during the period covered by this report, all of which were negative.

Miscellaneous Examinations.

The results of the work of the bacteriological department on milk, cream, ice cream and public and private water supplies is included in the report of the state chemist.

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The examination of milk for tubercle bacilli is not routine work. That there are being sold in open market milk and cream containing these germs, there can be no doubt. Samples submitted from city supplies often contain tubercle bacilli. The relation of the germ of bovine tuberculosis to that of man is an unsettled question, but enough has been determined to warrant the exclusion of milk from tubercular cattle for domestic use.

The laboratory test for tuberculosis in milk consists of the inoculation of Guinea pigs with the sediment obtained by the centrifuge. If the bacilli are present, the animal very soon develops the disease.

All samules of water from public and private supplies receive an examination for presumptive evidence of contamination from human excretions. This consists in most cases of the gas test in bile media; but in some cases a bacteriological count is made.

At present, the state makes routine bacteriological efficiency tests for the various filter plants in the state, and the results are found in the report of chemist.

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FINANCIAL STATEMENT.

EXPENSES OF THE STATE BOARD OF HEALTH.

For the Year Ending August 31, 1913.

Salary of Secretary	$2,500.00
Salary of Clerk	500.00
Expenses of Board, Incidentals and Office Supplies	416.69
Printing Blanks	172.85
Printing Report	813.01
Total	$4,400.55

Expenses for the Year Ending August 31, 1914.

Salary of Secretary	$2,500.00
Salary of Clerk	500.00
Incidentals	442.61
Printing Blanks	249.31
Total	$4,191.92

STATE LABORATORY OF HYGIENE.

Expenses for the Year Ending August 31, 1913.

Salaries (2 Chemists)	$3,000.00
Salaries (2 bacteriologists)	1,800.00
Printing Blanks	313.41
Incidentals	1,099.61
Total	$6,213.02

Expenses for the Year Ending August 31, 1914.

Salaries of Chemists (2)	$3,000.00
Salaries of Bacteriologists (2)	1,800.00
Incidentals	1,117.22
Printing	347.59
Total	$6,264.81

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SANITARY INSPECTION SERVICE.

Expenses for the Year Ending August 31, 1913.

Services and Expenses of Inspectors	$1,765.71
Incidental Expenses	716.43
Total	$2,482.14

Expenses for the Year Ending August 31, 1914.

Services and Expenses of Inspectors	$2,032.30
Incidental Expenses	211.55
Total	$2,243.85

EMBALMER'S LICENSES.

Received for 33 Licenses Issued	$165.00
Deposited with State Treasurer	165.00

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